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50 TOP PRODUCTS, THE 1994 BYTE AWARDS

BYTE

JANUARY 1995

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dBase for Windows

Quad-Speed CD-ROM Drives Deliver

Features Lotus Notes Users Want Most

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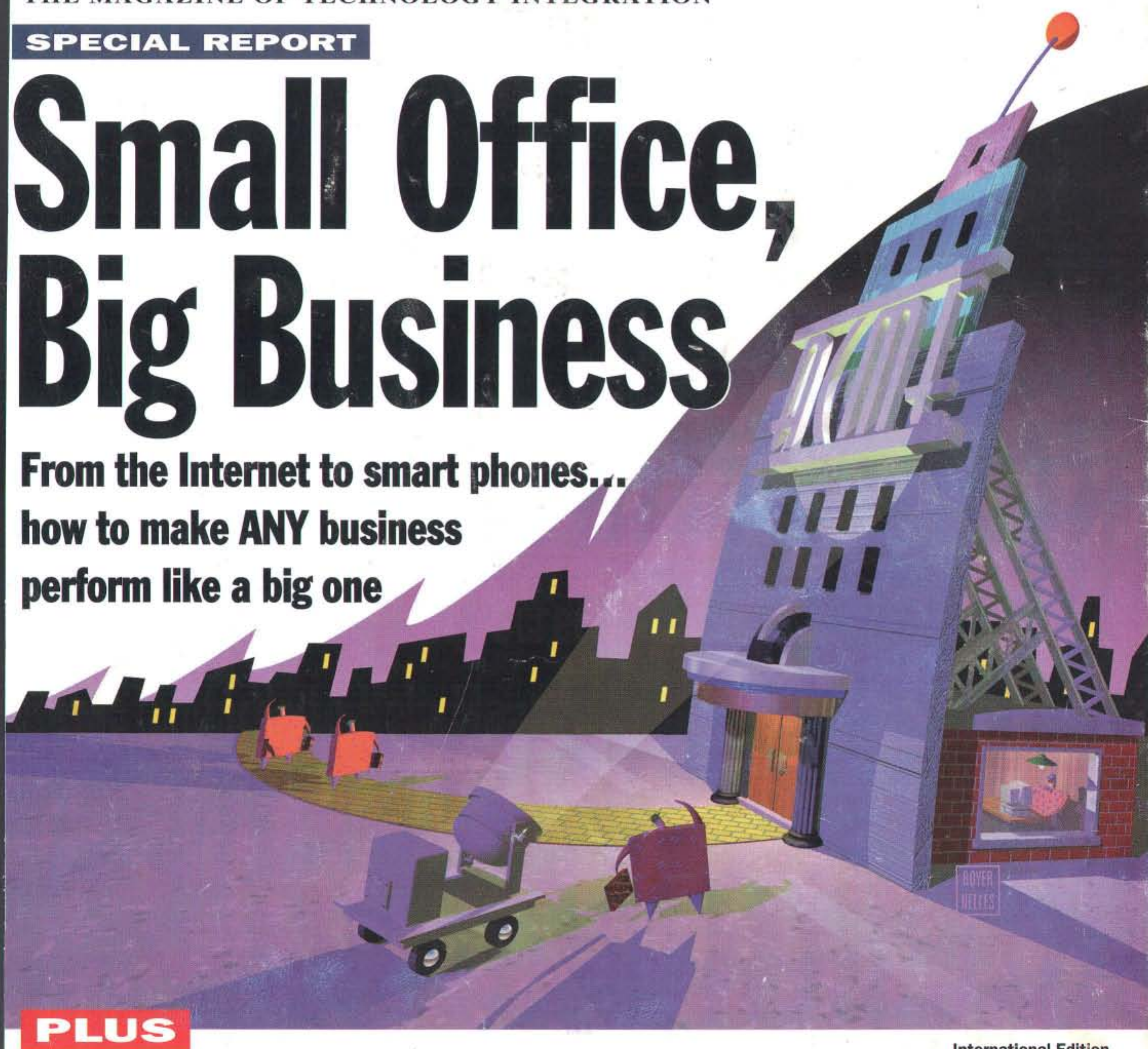

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From the Internet to smart phones... how to make ANY business perform like a big one

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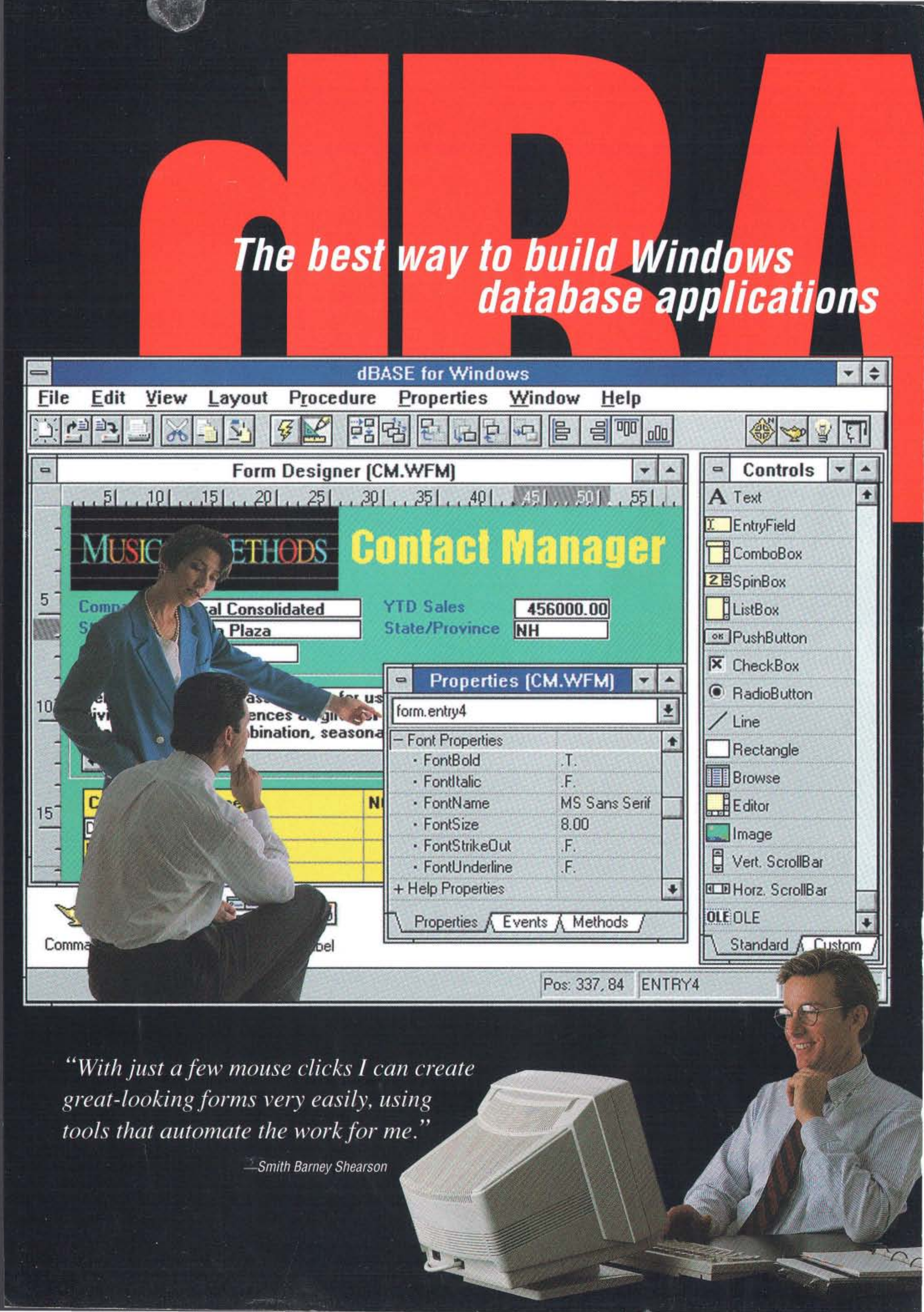

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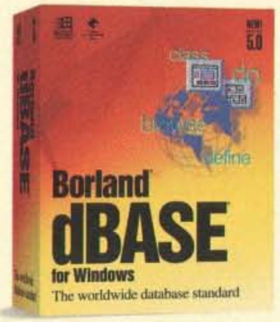

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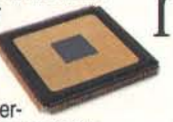

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BYTE

JANUARY 1995 VOL.20, NO.1

News & Views

GROUPWARE

What Notes Users Want............24

As great as Lotus Notes is for deploying productivity-enhancing applications throughout a company, it still suffers from numerous weaknesses. Here's what users want and a hint of things to come from Lotus.

WINDOWS DATABASES

End-User Windows Databases Take Off............................28

BYTE looks at three Windows database offerings—Microsoft Access 2.0, Lotus Approach 3.0, and Alpha Software's Alpha Five for Windows—that claim to be the best end-user database available.

STORAGE TECHNOLOGIES

15 MB in a Matchbook.............30

The storage capacities of personal communications devices, pagers, and digital cameras could improve greatly in 1995 thanks to a 32-Mb new flash memory device called CompactFlash from SunDisk.

WIRELESS TECHNOLOGIES

Infrared Gets Real..................30

The Infrared Data Association's new standard has vendors getting on board the infrared bandwagon.

VIDEO EDITING

Professional Video Prices Drop....34

Powerful desktop computers combined with new video editing programs are delivering professional video editing to the PC, Mac, and Power Mac platforms.

DOCUMENT MANAGEMENT

Indexing Gets Smart................36

Information publishers are turning to a new breed of smart indexing tools that can automatically summarize and condense huge documents without human intervention.

INTERNET COMMERCE

The Next On-Line Wave 40

On-line services are responding to the enormous demand of users for Internet accessibility by incorporating Internet access and tools.

NEW PRODUCTS

What's New 240

The PN60 prints color anywhere; CalcPac calculates in Windows; Duet puts a Mac voice in PCs; and more.

Special Report: Small-Office Computing

Small-Office Computing 120

BY PAULINA BORSOOK AND MICHAEL NADEAU

The Virtual Storefront 125

BY ANDREW SINGLETON

Making the Internet Connection—126

One Person's Internet Business—132

Curing the Windows Fax Blues 133

BY STAN MIASTKOWSKI

Doing It All on One Line 145

BY ANDY REINHARDT

Caller ID Goes to Work 149

BY GILBERT AMINE,
ANNETTE RIGGIO,
AND ELLIS HILL

High-Tech Bookkeeping 155

BY KEN SHELDON

Features

1994 BYTE Awards 49

COMPILED BY DENNIS BARKER BYTE editors pick the 50 outstanding products or technologies of the past year.

FIELD-SERVICE AUTOMATION

Solutions Focus: The Newton Goes Vertical 64

BY ANDY REINHARDT Why a maker of phone-testing equipment chose to repackage the Apple Newton MessagePad as its solution for client/server-based automated field service.

WORLD WIDE WEB

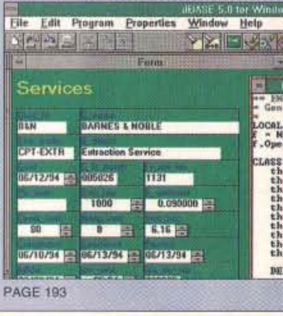
Mosaic: Beyond Net Surfing 75

BY JOHN R. VACCA This GUI navigator is also a tool for doing business on the World Wide Web.

Reviews

PAGE 175

PAGE 191



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06/13/94
06/13/94

PAGE 193

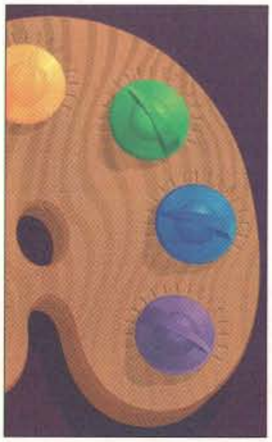
State of the Art

COLOR MANAGEMENT

Matching Colors 88

BY RUSSELL KAY

Getting the color you want without unpleasant surprises is no simple trick.



Consistent Color 93

BY MICHAEL SUGIHARA

New software standards help manage color for consistent and accurate reproduction.

On-Screen Color 101

BY BILL HILLIARD

Today's crop of monitors are producing better color than ever. Here are some tips on how you can pick the best monitor and video card to get the kind of color accuracy you need.

CD-ROM DRIVES

Quad-Speed CD-ROM Delivers 165

BY MICHAEL NADEAU Four new quad-speed CD-ROM drives are affordable if you work with high-speed video or animation.

IMAGE EDITING

Lively Pictures 171

BY TREVOR MARSHALL HSC Software's Live Picture is an impressive image editor for the Power Mac.

APPLICATION SERVERS

Apple's Workgroup Server 9150 175

BY RAYMOND GA CÔTÉ Apple presents its top-of-the-line PowerPC-based system as an application server.

PROGRAMMING

Prograph CPX: Purely Visual 179

BY RAYMOND GA CÔTÉ Macintosh programmers have access to a powerful visual-programming environment—and it's not from Microsoft.

PRESENTATION SOFTWARE

Software Roundup:
Powerful Presentations for Windows 183

BY SUSAN YEATON The traditional slide-show leaders—Charisma, Harvard Graphics, Lotus Freelance Graphics, and Microsoft PowerPoint—concentrate on power and usability.

PROJECTION PANELS

Audience Share 191

BY G. ARMOUR VAN HORN As more people incorporate sound and video in their presentations, projection panels must keep up. Proxima's new Ovation+ active-matrix LCD projection panels support 24-bit color and stereo sound.

DATABASES

dBase Does Windows 193

BY JIM CARLS The Windows version of dBase makes all the right noises in object orientation and ease of use, and it knows how to read old dBase files.

INTERNET INTERFACES

Internet with Style 197

BY BEN SMITH Netscape Communications' free Mosaic browser is optimized for 14.4-Kbps modem connections. Versions of its commercial Mosaic server offer security features to enable commerce on the Internet.

MODELING SOFTWARE

Bringing 3-D Modeling to PCs 201

BY EVAN YARES Autodesk releases AutoCAD Designer 1.0, a 3-D solid-modeling program.

LARGE-SCREEN COLOR MONITORS

Lab Report:
62 Big, Beautiful Color Monitors 204

BYTE/NSTL searches for the best 17-, 20-, and 21-inch monitors, using an extensive battery of tests to measure image quality, sharpness, contrast, convergence, legibility, power consumption, and distortion. We also evaluate ease of setup, controls, power management, and documentation.

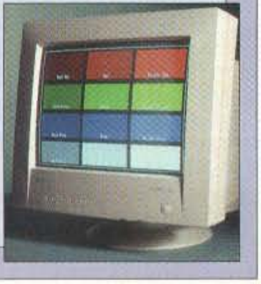
The Best 17-inch Monitors—206

How We Tested—210

The Best 20- and 21-inch Monitors—212

Honorable Mentions—216

Dubious Achievements—216



Final Output 109

BY MICHAEL WEISS
Color printers, more affordable than ever, hold out the promise of better color.

Core Technologies

PROGRAMMING

FPU Precision................223

BY OLIVER SHARP A simple comparison program can help programmers who grapple with FPU imprecision.

CPUS

AMD's 29030 Microprocessor..............225

BY FLOYD GOODRICH A flexible bus interface and the ability to sustain high performance with low-cost memory make the 29030 a good choice for the embedded market.

OPERATING SYSTEMS

The Oberon/F System 227

BY DICK POUNTAIN Niklaus Wirth's Oberon/F is a lightweight, portable, object-oriented component framework for the Windows and Mac environments.

NETWORKS

Daisy-Chain Ethernet 229

BY STAN MIASTKOWSKI Bring the legendary simplicity and flexibility of PhoneNet to the twisted-pair Ethernet LAN.

Opinions

Pournelle:
Communications Issues......231

BY JERRY POURNELLE Jerry discusses modems and networking.

Books and CD-ROMs:
Creating Life in a Computer..45

BY ANDREW SINGLETON AND RUSSELL KAY A look at books on artificial life and genetic programming and a CD-ROM on warplanes.

Commentary:
Who Needs the Internet?....296

BY RICHARD JENNINGS Heresy or a cogent view?

Publisher's Letter 14

BY DAVID EGAN

Blasts from the Past.........41

Highlights from two decades of covering the PC revolution.

Letters..........................18

Readers describe solutions using agent technology and express frustration with TCP/IP addressing.

Reader Survey 140

READER SERVICE

Editorial Index by Company 294
Alphabetical Index to Advertisers 290
Index to Advertisers by Product Category 292
Inquiry Reply Cards: 196A, 292A

BUYER'S GUIDE 249

Mail Order
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BYTE Contents by Platform

This page presents the articles in this issue according to computing platform.

DOS/WINDOWS

End-User Windows Databases Take Off........................28

Each of these three Windows databasesMicrosoft Access 2.0, Lotus Approach 3.0, and Alpha Software's Alpha Five for Windowscomes with a rich toolset designed to enhance your productivity as soon as you tear into the box.

Professional Video Prices Drop............................34

Premiere 4.0, Adobe's professional-level video-editing program for Windows, the Mac, and the Power Mac, offers many new features that will appeal to video professionals.

Curing the Windows Fax Blues..........................133

Here are some tips on troubleshooting fax modem problems to get your fax modem working in your Windows PC.

Caller ID Goes to Work......149

Borland's Sidekick for Windows is among a growing list of applications progams incorporating caller ID capability into its list of features.

High-Tech Bookkeeping.....155

Two technologies that may change the way businesses keep their books on computer are OLE and on-line electronic services. Peachtree Accounting for Windows, MTX Accounting from MTX International, and Intuit's Quicken 4 for Windows all make use of OLE technology.

Powerful Presentations for Windows..................183

Windows offers the right environment for presentation software. Presenters can preview their work or deliver a presentation from a notebook PC. The traditional slide-show leaders—Charisma, Harvard Graphics, Lotus Freelance Graphics, and Microsoft PowerPoint—concentrate on power and usability.

Audience Share 191

Proxima's Ovation+ projection panels let you project Windows presentations with animation or video. The active-matrix LCD panels support 24-bit color and stereo sound.

dBase Does Windows........193

dBase for Windows is finally here, and it's a real Windows version, with drag-and-drop querying and new object-oriented language extensions.

Bringing 3-D Modeling to PCs.........................201

Autodesk Designer was conceived as a relatively low-cost alternative to workstation-based solid-modeling programs. Version 1.0 is a decent first effort, but it lacks many of the precision tools that serious CAD users require.

OS/2

Code Talk: File I/O on Objects, Instead of Bytes...............40

This month Grehan takes a look at Gamelon, an object-oriented file access library for OS/2, Windows, and Windows NT.

MACINTOSH

Professional Video Prices Drop............................34

If you want professional-level video editing and don't mind mixing, matching, and verifying hardware and software components, Adobe's Premiere 4.0 for the Mac, Power Mac, and Windows offers a low-cost alternative.

Lively Pictures................171

Macintosh-based artists have much to cheer about with HSC Software's Live Picture, which brings high-end workstation editing to the Power Mac. Tests reveal minor problems with pixellation at some zoom levels, however.

Apple's Workgroup Server 9150..........................175

Here's a look at Apple's high-end PowerPC-based application server.

Prograph CPX: Purely Visual 179

State-of-the-art visual programming on the Macintosh is fully extendable to keep up with changes to the Mac Toolbox.

Audience Share 191

With Proxima's Ovation+ projection panels, you can project animation and video from your Mac at 640 by 480 resolution. The active-matrix LCD panels support 24-bit color and stereo sound.

UNIX

The Oberon/F System 227

Oberon/F, an object-oriented component framework, is currently in beta for Windows and the Mac. Versions are also planned for Unix/Motif and OS/2.

NETWORKS

Mosaic: Beyond Net Surfing 75

While the Internet provides access to a worldwide collection of information resources and services, navigating the network can be frustrating and confusing. Mosaic is a GUI navigator and a tool for conducting business on the World Wide Web.

Making the Internet Connection 126

If you're thinking about connecting to the Internet, you may just need dial-up access or you may need a full-fledged Internet protocol connection. Be sure and consider the pros and cons of each.

Apple's Workgroup Server 9150..........................175

Apple's top-of-the-line PowerPC-based application server provides a variety of network services, such as automatic cataloging, prepress color separation, printing, and fax communications.

Internet with Style 197

Netscape Communications offers Mosaic browsers optimized for 14.4-Kbps modem connections, and its servers offer the encryption and security to run a commercial service on the Internet. You can even set up a site local to your LAN if you just want to publish corporate information to your local users.

Daisy-Chain Ethernet........229

Farallon Computing and Tut Systems are both challenging conventional wisdom by offering daisy-chain Ethernet using inexpensive and easier-to-install copper wire instead of coaxial cable. We examine Farallon's EtherWave and Tut's Silver Streak.

Pournelle: Communications Issues.....231

Jerry discusses networking and communications issues.

Index

Accounting 155

Adaptive computing 36

Awards..........................49

Books...........................45

CAD 201

Caller ID......................149

CD-ROM drives................165

Color..............88, 93, 101, 109, 204

Communications....24, 30, 75, 125, 133, 145, 231

Computer telephony....145, 149

CPUs 225

Databases...............28, 193

Document management.........36

Graphics...............171, 201

Groupware 24

GUIs 36, 75

Image editing.................171

Indexing........................36

Internet 40, 75, 126, 132, 197, 296

Modems 133, 145, 231

Monitors...............101, 204

Multimedia 191

Networks 75, 175, 197, 229, 231

Operating systems 227

PDAs...........................64

PowerPC..........34, 171, 175

Presentations..........183, 191

Printers.......................109

Programming......36, 40, 179, 223, 227

RISC..........................225

Servers.......................175

Small-office computing.......120, 125, 133, 145, 149, 155

Storage........................30

Video..........................34

Wireless.......................30

World Wide Web.........75, 125

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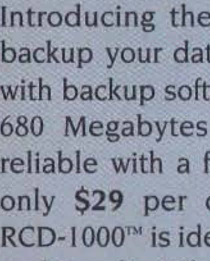

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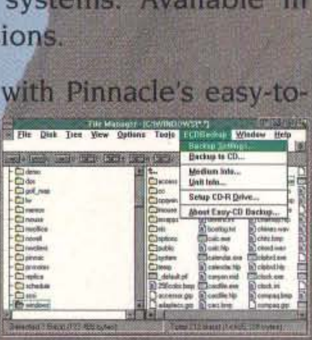

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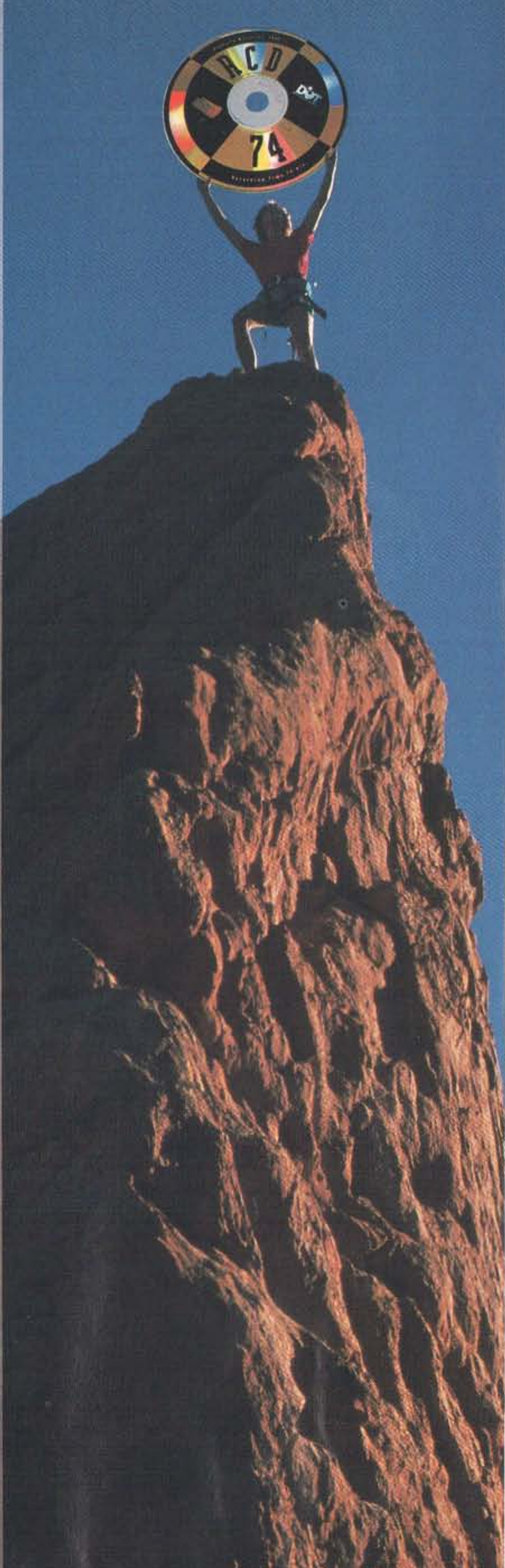

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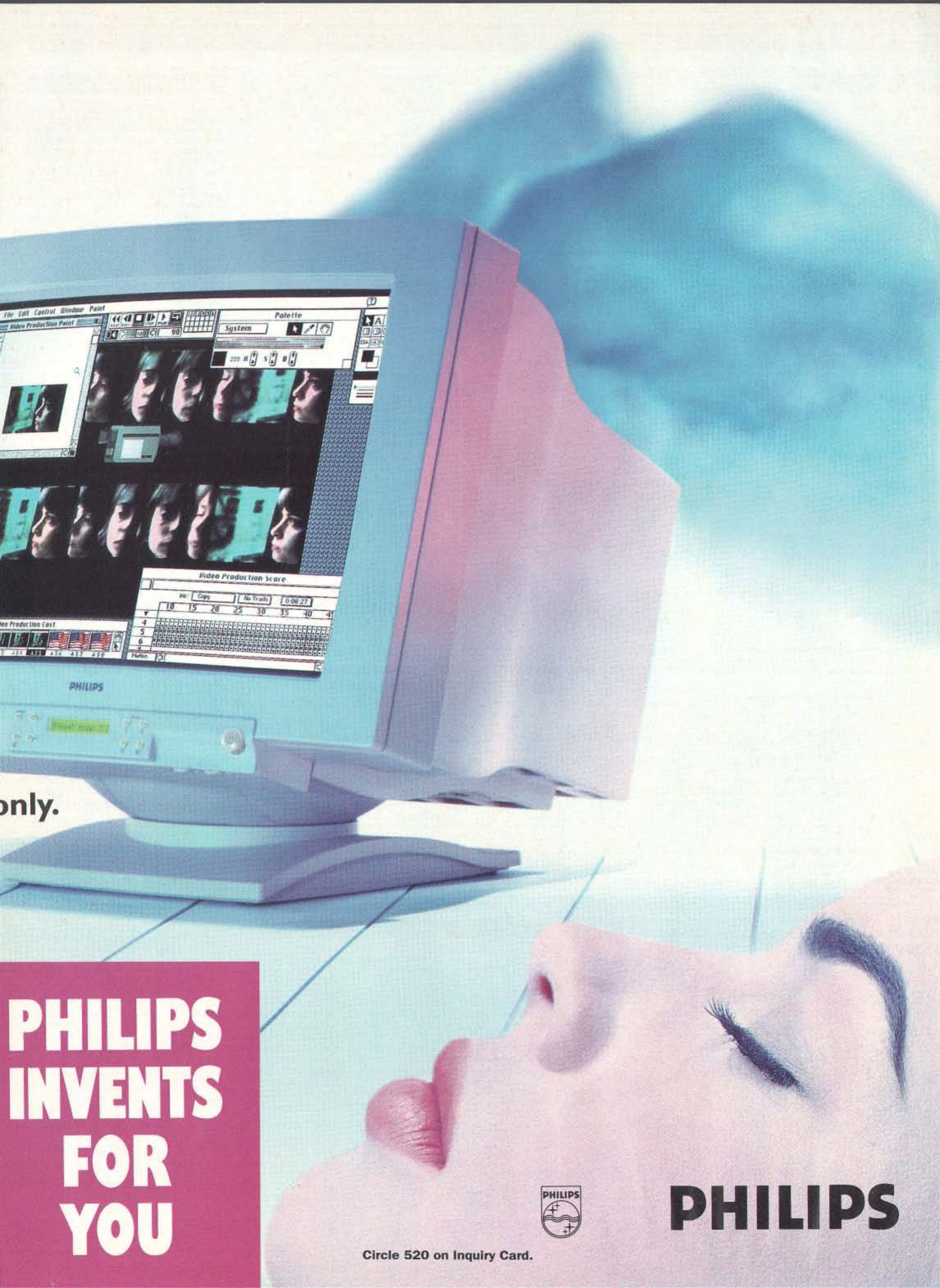

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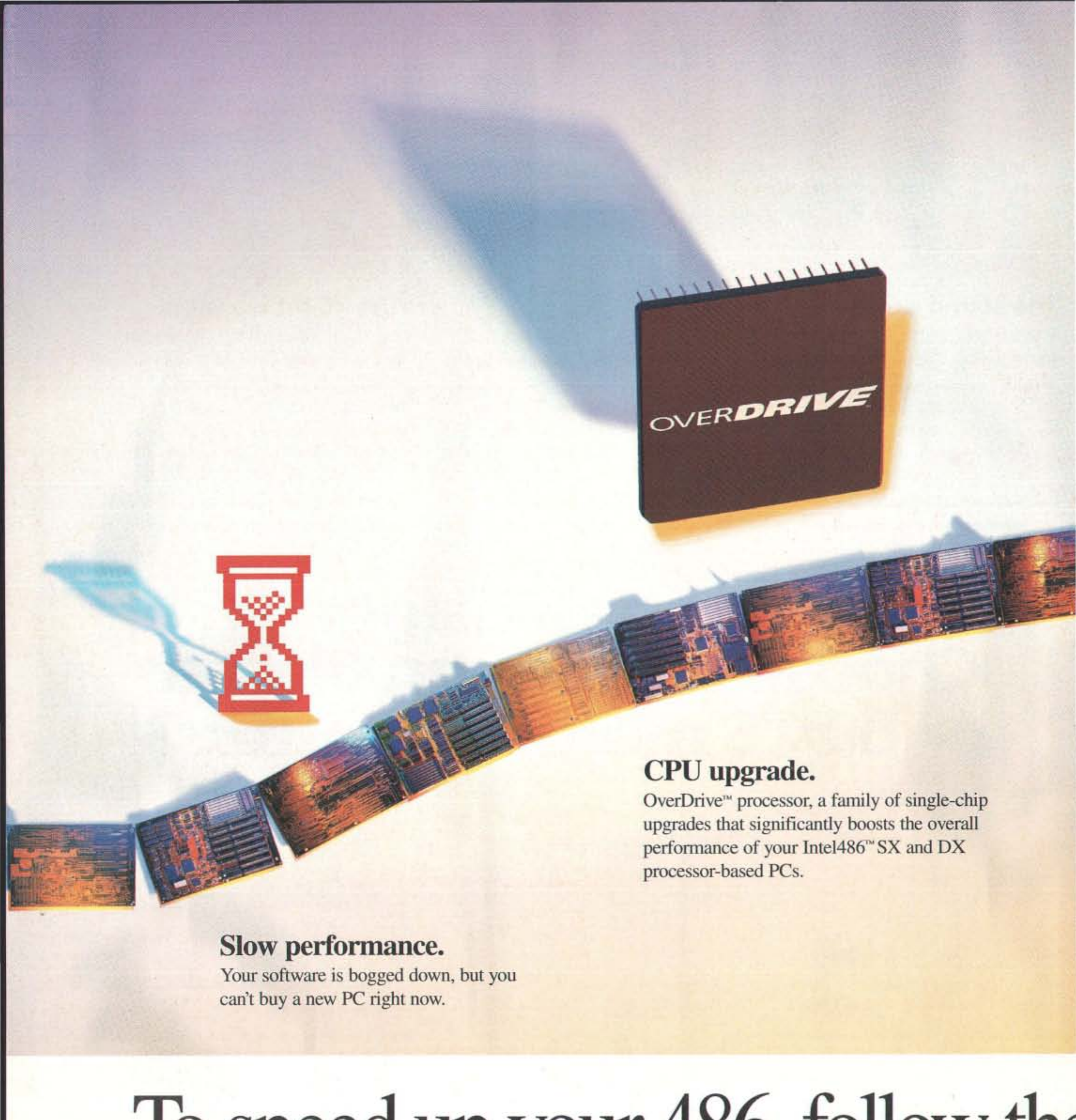

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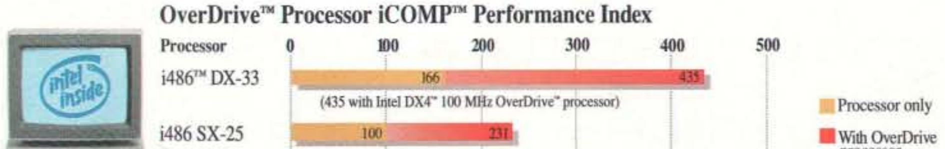

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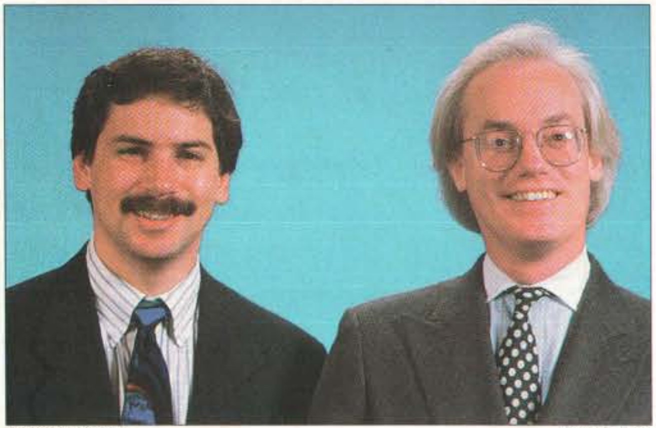

Raphael Needleman

David B. Egan

And 1995, which includes our 20th anniversary issue in September, will be even better

For the most part, the publisher manages the business interests of a magazine. I worry about such matters as policy, our views on key issues effecting our marketplace, and what kind of resources BYTE needs to continue creating a product that engages your attention. There are very few occasions on which I can talk to you directly in the magazine. This is one of those occasions. As we begin the new year, let's look back on the one we just finished. From a business perspective, 1994 was a good year for BYTE. While a number of other major computer magazines dropped in total advertising pages and circulation, BYTE surged ahead in year-to-year advertising sales and posted impressive gains in subscription-renewal rates.

The advertising statistic may be of little interest to you as a reader, except as an indicator of the growing importance your attention and opinion have on those who develop the hardware and the software to meet your demanding technology needs. Obviously, the rising renewal rate is of great interest to us. You are the technically astute opinion maker who drives today's purchasing of computer technology, and the fact that you're renewing your subscription tells us that we're successful in our efforts to meet your information needs. In fact, a recent study told us that nearly nine out of every ten of you plan to renew your subscriptions to BYTE. Thanks!

I think we've earned your loyalty through standards-setting editorial work. Our November cover story on the fierce competition between new CPUs is already widely touted as a definitive evaluation and comment on the promise of this leading-edge technology. West Coast Bureau Chief Andy Reinhardt's comprehensive March cover story on the Internet ("Building the Data Highway") has earned a number of accolades. And we're still getting feedback—supportive and otherwise—to Jon Udell's opinion piece, "Why IBM Should License Win32," in last September's issue.

Delighted as I am to write this, I must also confess that this is a bittersweet moment for BYTE, for this marks Dennis Allen's departure from our magazine. Part of our editorial organization for more than eleven years, Dennis served as our editor-in-chief for the past three. After more than a decade of service, Dennis has decided to move on to new challenges. We'll miss him; and we wish him well. On the page that follows, Dennis writes more eloquently than I about the memories he takes with him. His legacy lives in the pages of this publication, one of the most widely read and respected journals of computing technology in the world.

The younger looking fellow in the photo above is BYTE's new editor-in-chief, Raphael Needleman. Rafe brings to his new assignment impressive credentials: He's an accomplished technologist, book author, testing lab manager, and world-class editor. His background includes duties as executive editor of *PC/Computing*, editor of *Corporate Computing* (where he and I first worked together), and reviews editor at *InfoWorld*. I'm delighted to have Rafe join our team. He'll offer BYTE a fresh perspective and will work to make it even more relevant and compelling reading for those of you who turn to our magazine for the authoritative word on computing technology.

I look forward to talking to you in these pages again in our 20th anniversary edition of BYTE, coming up this September. Meanwhile, let us know how we're doing at meeting your information needs. Please write to Rafe and me. We're here to serve you.

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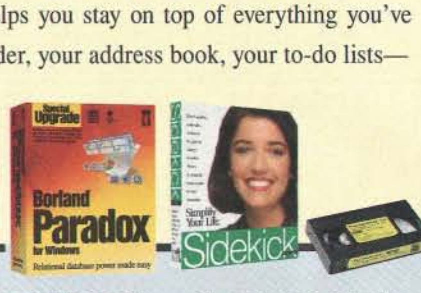

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Good-bye, Farewell, Adios. . .

Saying goodbye is never easy. Yet the time has come for me to leave BYTE.

After more than eleven years here, BYTE has become a part of me, and leaving it is not without some sorrow. It's a good kind of sorrow, though—the kind you feel when you graduate from school and the new opportunities are boundless and exciting.

Thanks to you, my experience here has been wonderful. Together, we've seen BYTE through many changes, and we've endured the ever-changing technology landscape. I hope that you've enjoyed the experience as much as I have.

During the last three years, BYTE moved back to its technical roots. And while all the other computer magazines seemed to become more and more alike, BYTE's authoritative voice made it stand head and shoulders above the rest. As a result, the *New York Times* and others have hailed BYTE as the *Scientific American* of computer magazines.

Compliments aside, the changes BYTE made were simply an answer to your requests. Judging by your response, those changes were right. Subscription renewals are up, and on the newsstand, BYTE broke several all-time records in 1994. Also, the mail we've received from readers has been overwhelmingly positive.

Those changes were not easy, however, and the entire BYTE editorial team has my applause and appreciation. Nowhere else is there a group of more qualified technical journalists, editors, and designers. Nowhere. It has been my distinct privilege to work with such a fine group of people, and I shall not forget their hard work.

Although all of the people of BYTE have my profound thanks, there are two very special individuals whom I'd especially like to thank: Rich Friedman, BYTE's executive editor, and Dennis Barker, BYTE's chief of correspondents. Both played crucial roles in making BYTE *the* authority in computing. Their publishing and editing skills and their dedication to BYTE has been exemplary. They are also two close friends I will miss dearly.

Another friend I'll also miss is Jerry Pournelle, BYTE's star columnist. Jerry has contributed to BYTE much more than the several thousand words he writes each month. He has shared his wisdom with the staff, and he provided inspiration for me.

While I will surely miss the entire staff at BYTE, I leave knowing that BYTE is in good hands. I personally testify to their dedication in delivering nothing short of excellence in technical reporting and fact, and I am certain that you will continue to be delighted with each issue of BYTE they bring forth.

The folks I'll miss most of all, though, are you, the BYTE readers. You have made every accomplishment possible. From its beginnings 20 years ago, BYTE and its readers have had a special relationship that is rare in publishing, and I've enjoyed being part of that relationship. You bestowed on me the greatest honor any chief editor could have: You read the magazine. And by reading, you made everything worthwhile.

Words fail me in adequately expressing my deepest gratitude. You challenged me, and you rewarded me. Thank you.

My work here is done. I am proud of my labor and accomplishments at BYTE, but like a graduate, I'm ready to move on to other challenges.

Adios,

DENNIS ALLEN

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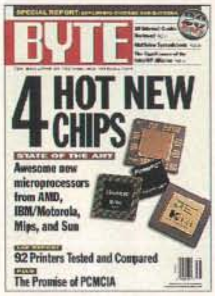
It appears a bug is in the FPU of many Pentium processors. The Pentium FPU returns erroneous values for certain division operations. For example, an error is obtained by calculating 1/(1/x) for values in the range 824633702418 <= x <= 824633702449 and throughout any interval obtained by multiplying or dividing the above interval by an integer power of 2. Other intervals also produce division errors. These errors can be verified in compiled code, an ordinary spreadsheet, or even the Windows calculator in scientific mode.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We observed the bug on all the Pentiums we tested, including a Dell P90, a Gateway P90, a Micron P60, an Insight P60, and a Packard-Bell P60. It has not been observed on any 486 or earlier system. I am interested in hearing of test results from other Pentiums, from 486-DX4s, and from the AMD, Cyrix, and NexGen clones of the Pentium.

Dr. Thomas R. Nicely
Professor of Mathematics
Lynchburg College, VA

We tested Dr. Nicely's claims on various Pentium machines, and the error is as described. We contacted Intel, and John Thompson, an Intel spokesperson, confirmed our findings. However, the error is confined to the lowest bits of the mantissa (usually the lower 9 or 10 bits), so it is unlikely that anyone would encounter it. Thompson said that Intel's statistical analysis of the bug indicated the problem would occur once every 9 to 10 billion operand pairs (an operand pair being an expression such as a+b, a–b, and a×b). Corrected Pentium processors are already in the manufacturing pipeline. Finally, Thompson said that readers should contact Intel if their particular applications run afoul of the bug and that Intel will "work with them to solve the problem."—Rick Grehan

The Future Is Now

I was intrigued by your recent cover story on Intelligent Networks ("The Network with Smarts," October 1994) but worried as well. Everything you presented was in the future tense, although every type of technology you described is available by using Lotus Notes and products from Lotus's Business Partners Program.

Reexamine the dream scenario offered in the article: "If I get a fax from Toshi regarding the Kyoto project, please run it through OCR and read it into my voicemail box, send a copy of the text to Barbara, and forward the fax image to the optical-archive mailbox in the legal department."

Okay, that's a pretty tall order, but in two weeks, I could set up such a system for you. You can create information-seeking agents using SandPoint's Hoover product; fax integration with OCR is available from Lotus and from other vendors. You can develop voicemail integration and phone client services using the Phone Notes client developed jointly by Simpact and Lotus. Also, imaging integration is available from a variety of vendors, including Lotus itself with LN:DI. SkyTel offers pager-integration, and voice-recognition systems from IBM fulfill the dream. These can all be found on the Notes platform today; there's nothing future tense about these technologies.

Nathan Freeman
New York, NY
freeman@mfj@notes.net

Addressing Addressing Standards

In "Automating TCP/IP in NT" (November 1994), Peter Wayner says that if he uses Microsoft's WINS (Windows-Internet Naming Service) to provide name-to-address-translation service on a Microsoft-based TCP/IP network, no one outside of that network will be able to get to him by name. I think it's Microsoft's fault for not making WINS work with DNS, the Internet's Domain Name Service; after all, DNS has been around much longer and is an internationally accepted standard. By not working with the widely used standard, WINS users will have cut themselves off from the rest of the world. I'm glad to see that Microsoft is trying to work through the IETF (Internet Engineering Task Force) to resolve the differences. Let's hope the operative tone here is "work with" rather than "dictate to."

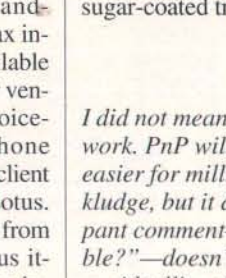
Doug Loss
Wilkes-Barre, PA
loss@husky.bloomu.edu

Sugar-Coated Reporting?

In the November BYTE Letters, Don Leamy points out that PCs can *never* be PnP (Plug and Play) due to built-in deficiencies. He criticizes BYTE for not being up-front and frank in its assessment and for not "telling it like it is." Tom Halfhill excuses BYTE's lack of candor, indicating the decision not to provide the whole truth was due to reasoning, "Why burst their bubble [of mistaken judgment and ignorance]?". Might I suggest that BYTE tell the real truth as it is—not the half-truth or sugar-coated truth?

Joel Amkraut
Los Angeles, CA

I did not mean to imply that PnP won't work. PnP will work and will make life easier for millions of PC users. PnP is a kludge, but it does work. My rather flippant comment—"Why burst their bubble?"—doesn't mean that BYTE should avoid telling the truth. It doesn't matter if the Macintosh has better plug-and-play capabilities than the PC because most PC owners aren't going to sell their systems and buy a Macintosh. It matters only to people who haven't yet decided between a PC and a Mac. But the tens of millions of current users deserve a solution, too. So far PnP is the best solution to make PCs easier to use, while preserving as much of PC owners' current investment as possible.
—Tom Halfhill



Recycling Technology

In the "VLIW Questions" article in November, Peter Wayner states, "VLIW [very large instruction word] is a new way to attack an old problem." But VLIW is what used to be called *microcode*. End users could write microcode through hardware options on systems from Data General and DEC, though few were desperate enough for the performance to do so. Look at the internals of systems as far back as IBM 360 and 370 mainframes, and you'll see similar techniques. I'm much more impressed by efforts such as Motorola's

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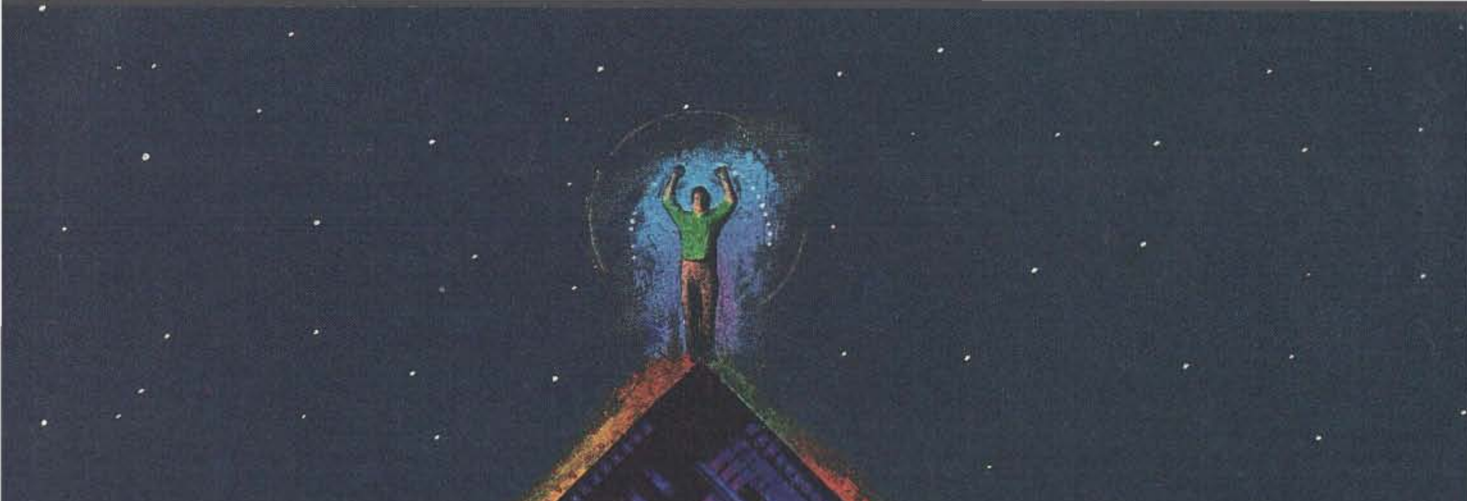

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Harlan Rosenthal
rosenthh.dialogic@pobox.dialogic.com

Like microcode, much of what is old is new again, but smart compilers are an important part of VLIW, whereas microcode was written by hand.
—Peter Wayner

Inheritance in PowerBuilder

In the well-structured software roundup "SQL Front Ends for Windows" (October 1994), Mark Hettler and Scott Higgs give a largely accurate view of PowerBuilder 3.0a. But they miss a couple of tricks. They say that "you cannot derive a user object from a button." In fact, PowerBuilder provides standard user objects that provide this capability. These specialized standard objects can have events, scripts, functions, and variables added. At Ernst & Young, we use standard user objects extensively to provide common user-interface functions across a range of commercial software.

The authors also imply that user objects can be shared by moving them between libraries. PowerBuilder not only allows a library of user objects and other reusable components to be part of several applications, it also allows inheritance of these objects into specialized objects. We use this feature extensively as well. All our commercial applications inherit from objects in a shared ancestor library.

James Taylor
Development Manager, Ernst & Young
Las Colinas, TX

Developing Hardware-Independent Software

I have been following the discussions in BYTE on new microprocessors and systems, and I keep reading that "the code has to be recompiled to take advantage of the CPU." When I read about VLIW's (very large instruction word's) need for smart compilers, I wondered why I hadn't seen any mention of reassemblers. By *reassemblers* I mean programs that take a binary and generate a new binary optimized for another CPU. Here you have the K5 reconstructing CISC into RISC on the fly; you have processors spending huge numbers of transistors trying to execute code out of order to take advantage of superscalar pipelining; and you have PowerPC emulating binaries. These all seem to lead to an obvious approach of spending the time once in software to determine what one binary is doing and then to generate a new binary that takes advantage of another CPU's strengths.

Alan P. W. Hewett
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The actual term for your reassembler is binary translation, *and the short answer is that it does exist. Echo Logic (Holmdel, NJ) has a technology called FlashPort that can translate among several different binary formats, including 680x0 to PowerPC and x86. DEC also has a translator that moves VAX binaries to Alpha. But binary translation is not an answer to the questions of RISC vs. CISC, optimized compilation, or VLIW. Also, there are some unanswered legal questions if you translate a binary without authorization from the original software developer.*

I think there are other approaches yet to be explored that address these problems. For example, what if software was delivered in some form of pseudocode that could be compiled and optimized for a specific computer as part of the installation process? You could buy an application in a semicompiled format, and the installer would automatically compile and optimize the code. If you later upgrade to a completely different platform, the software would get recompiled again on installation, using a plug-in installation compiler. This arrangement would insulate the software from details of the hardware and still achieve optimum performance and compatibility without emulation.—Tom Halfhill

Microsoft Hardware

When Windows was first released, Microsoft offered us the mouse—not just any mouse compatible with the existing mice of the day but a special mouse. Now Microsoft is set to improve our lives again with Chicago, a more user-friendly Windows to replace Windows. And to top it off, the company has moved into hardware with a keyboard that has three extra keys for special functions within Chicago. It couldn't find room on the old keyboards. Isn't it wonderful to see such a great company dedicated to improving our lives without letting compatibility stand in the way of profit?

Gordon Reid
Moorabbin, Victoria, Australia

FIX

The Xerox 4520 laser printer in the November 1994 Lab Report is the 4520mp, not the 4520ps. That report also listed an incorrect price for the Hewlett-Packard DeskJet 1200 C/PS. The correct price is $2479. ■

COMING UP IN FEBRUARY

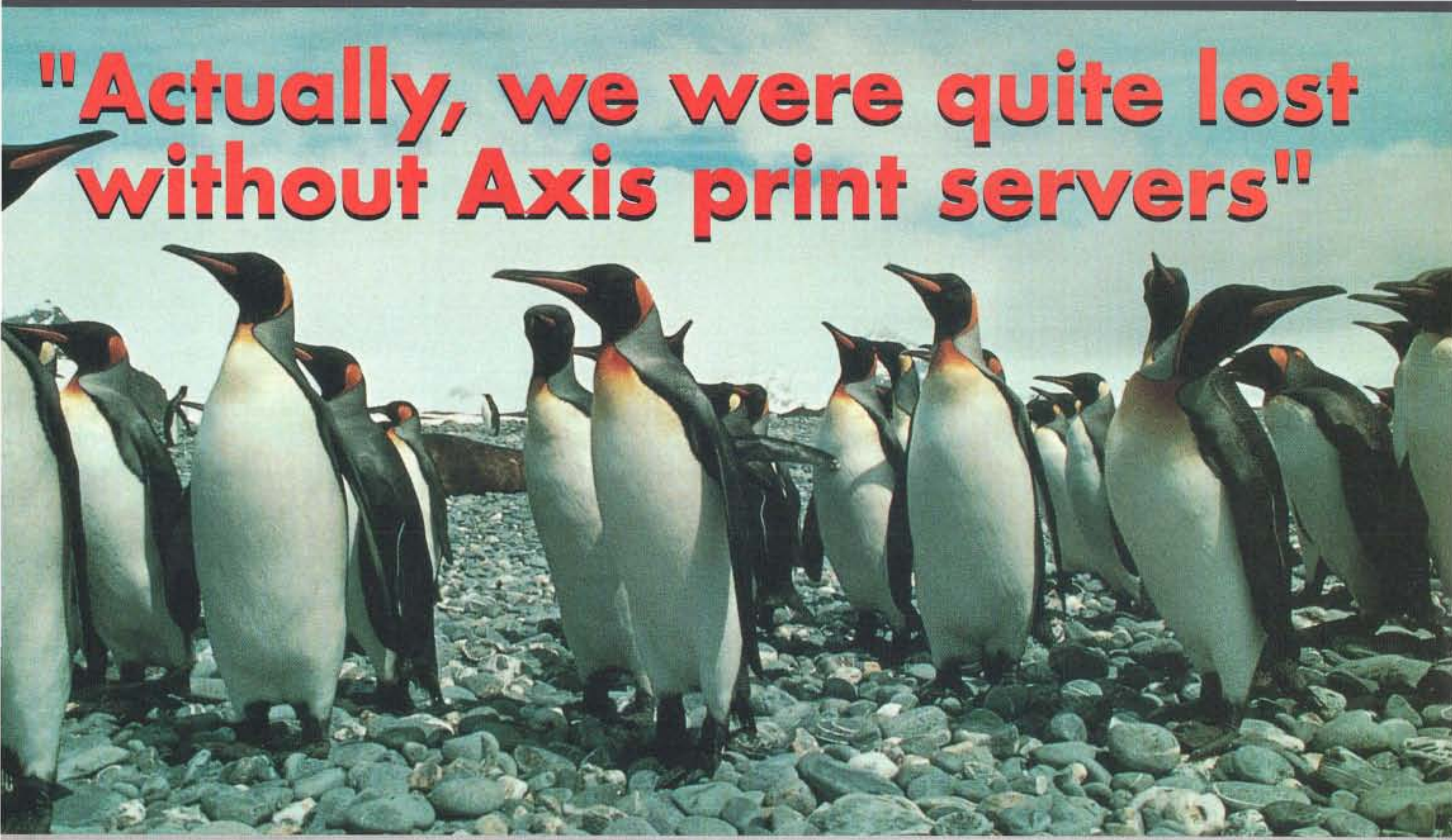
• SONY MAGIC LINK
Does the first portable computer to incorporate General Magic's Magic Cap operating system and Telescript technology fulfill the vision of a personal digital assistant?

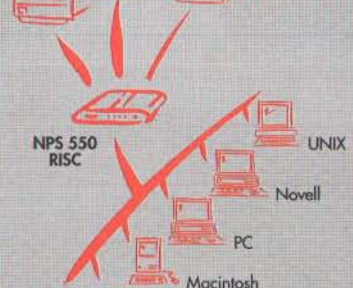
• 41 GRAPHICS ADAPTERS
If you're wondering whether it's worthwhile to upgrade your PCI or NuBus graphics adapter, the NSTL/BYTE Lab Report will feature extensive performance results for CAD and general business, as well as explanations of the special hardware support for video and 3-D technology.

• SCALABLE RAID
We test the performance and reliability of RAID systems for cross-platform environments and scalable needs.

• STATE OF THE ART: PATTERN RECOGNITION
Communicating with your computer in a natural way, using handwriting or speech, demands sophisticated pattern-recognition capabilities. It is simple for humans, but very demanding for PCs.

• LAN OPERATING SYSTEMS
Following up on our peer-to-peer operating-systems roundup, this month we examine larger-scale operating systems for enterprise networks.





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News & Views

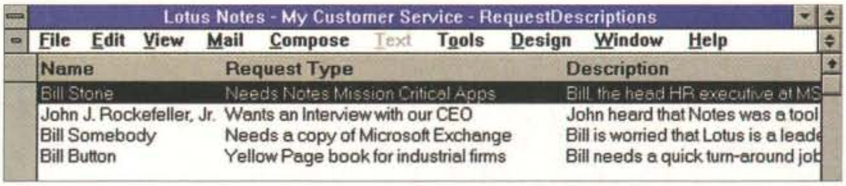
GROUPWARE

What Notes Users Want

As great as Lotus Notes is for deploying productivity-enhancing applications throughout a company, it still suffers from numerous weaknesses. Here's what users want, as well as a hint of things to come from Lotus.

RICK DOBSON AND DAVE ANDREWS

From its beginning in 1989 as a client/server platform for deploying distributed work-flow and communications applications, Lotus Notes has grown into a leading groupware platform, with an installed base of almost 4000 companies and more than 1 million users worldwide. Managers at companies big and small alike say that Notes' document databases are an excellent way to store unstructured data. Notes users can access multiple databases of documents, participate in electronic discussions, and route messages to quickly access and disseminate information. However, if you scratch the surface of a typical Notes success story, you'll often find a tale of administrative and programming complexities. An informal survey conducted by BYTE of chief information officers (CIOs), developers, and users indicates a number of areas where Notes could improve (see the text box, opposite page). Lotus hopes to address these and other concerns in a major upgrade of Notes that the company hopes to release in the middle of this year.



Name	Request Type	Description
Bill Stone	Needs Notes Mission Critical Apps	Bill, the head HR executive at MS
John J. Rockefeller, Jr.	Wants an Interview with our CEO	John heard that Notes was a tool
Bill Somebody	Needs a copy of Microsoft Exchange	Bill is worried that Lotus is a lead
Bill Button	Yellow Page book for industrial firms	Bill needs a quick turn-around job

Many users want the Notes interface improved. Notes currently limits its Views to one line, which arbitrarily cuts off the descriptions shown on the screen.

Notes is now available in server versions for OS/2, NetWare, Windows, Windows NT, and Unix, and in Windows, OS/2, Unix, and Macintosh client versions. The product provides a platform for a multitude of decision-support, customer-service, and problem-resolution applications developed by internal corporate programmers and third-party developers. "There's almost nothing I can think of that we don't use Notes for," says Jim Charles, CIO at Computer Language Research, a tax-automation software company based in Dallas, Texas. "It's how we have reengineered, to use a cliché, our company," he adds.

Other software companies have released programs that compete with certain aspects of Notes (e.g., BBSes for electronic discussions, E-mail programs, relational databases with replication, and work-flow management programs), but no currently available product directly competes with the document-based Notes. Microsoft's Exchange Server and Oracle's Documents might challenge Notes, but neither product is slated to ship until later this year.

Meanwhile, CIOs working at large, multiple-server Notes installations say they lack tools for managing and fine-tuning their Notes installations. Developers who have mastered the Notes macro language for creating applications lament the lack of an integrated procedural language similar to Visual Basic. In addition, our interviewees say that Notes could beef up its reporting capabilities, further improve the efficiency of its replication engine, and introduce more granular control of replication options. A number of users also asked for an overall increase in speed, lower cost, improved database access, and a better interface for end users.

Lotus says version 4.0 of Notes will address most of its users' requests. The company said it's still too early to disclose details, but it announced general goals for version 4.0 when it made a prerelease version available to about 200 Notes developers in October.

Lotus says Notes 4.0 will let end users create agent programs that perform such activities as scanning news wires for specified information. Mobile users will find it easier to connect to a Notes network, and they'll be able to preconfigure their systems to selectively extract information, such as key portions of Notes databases, the latest mail messages, or appropriate modem dialing rules, in background mode. The Notes Mail interface will be replaced by cc:Mail. Notes' user interface will be enhanced, making it easier for users to store and navigate information.

Lotus also said that it will improve the performance of Notes' servers, increase the number of users supported by each server, and offer tools for easier administration and management. With LotusScript, developers will have access to a BASIC-like scripting and macro language that will also work with other Lotus and non-Lotus applications. The company says that LotusScript will communicate with other scripting languages—such as Visual Basic, Applications Edition—through platform scripting interfaces such as OLE 2.0 automation.

The early word from developers who have seen or are using the alpha version of Notes 4.0 is that it's an ambitious upgrade that will address many of the product's current weaknesses. With Notes, Lotus already provides a platform that can literally allow a company to reinvent itself, but the process usually requires a good deal of effort. Lotus hopes that the next release of Notes will solidify the company's position in the ever-evolving groupware market.

NOTES' STRENGTHS AND WEAKNESSES

BYTE conducted 15 interviews with CIOs of companies that use Notes; the goal was to learn what they like about Notes and what they'd like to see improved.

What Users Like About Notes

Improved communications. Interviewees universally praise Notes for its ability to open new channels for customer communications while improving a company's internal communications, both within and across departments. "Notes does not come in and hit just one horizontal section of your company," says Mike Bertrand, president of Notes consultancy Uptime Computer Solutions (San Jose, CA). Instead, he says, Notes typically fosters improved communications that span a company's departmental boundaries.

It's easy to program and use. CIOs say that writing and fielding a complex work-flow application with Notes requires programming expertise, but they also say it's easy for end users to develop their own applications and customize existing ones. "That's an incredibly important feature—that our users can build applications without any input from MIS," says Sheldon Laube, national director of information and technology at Price Waterhouse in Menlo Park, California.

Notes Mail. Users like the basic functionality of Notes Mail. Although some complain that it lacks rules and is somewhat inefficient, they like the fact that it's easy to forward documents and embed graphics and spreadsheets into mail messages.

Work flow. Developers throughout the world have written distributed work-flow applications that run on top of Notes.

Built-in security. Some CIOs say they won't even consider any platform for fielding applications that are replete with sensitive customer information unless it has the level of security that Notes has.

What Users Would Like Improved

Notes' programming environment. Several developers and CIOs lament the Notes macro language's lack of support for even basic FOR...NEXT looping capabilities. Most say they're looking forward to Lotus's integrating LotusScript, the company's BASIC-like programming language, into Notes. Most express the hope that LotusScript will support OLE Controls.

Replication. Replication is a key feature in Notes. Notes 3.0 introduced selective replication, which can reduce network traffic, but administrators, especially those with large worldwide Notes installations, want a more efficient replication engine and finer control over its options. "Field-level replication would be a very nice feature," says Mike Mandelvaum, vice president of information technologies development for Chase Manhattan.

Administration. Interviewees' requests for improving Notes' management and installation tools range from improved network-monitoring tools to a utility that would convert a Notes mail-address book from flat-naming to the newer hierarchical storage scheme. Lotus's partnership with AT&T portends less administration hassles on the back end.

Cost. It currently costs about $330 per seat for Notes' client software, but that's just the beginning of the price of a Notes installation. Adding Notes to your network can require RAM and computer upgrades, plus the related additional management headaches.

To address the price issue, Lotus has introduced scaled-down Notes Express clients that cost approximately $99 per seat. But Notes Express won't run your custom applications. "We would really like to see a Notes run-time version that strips out the development tools," says Rick Bernard, information systems manager at Software 2000 (Hyannis, MA). "In our eyes, Notes Express has a limited use for our needs," he adds. "We need a version of Notes that will allow us to execute a custom application, and Express will not do that."

Reporting and database access. Many interviewees are using products such as Lotus's Notes ViP and Brainstorm Technologies' (Cambridge, MA) VB/Link to complement Notes' basic reporting capabilities; a need for better integrated reporting is a common theme. Also, Notes is not designed to support transactional processing tasks performed by relational databases. But users sometimes want to import structured data into Notes in batch operations instead of using `@dbLookup`. This is why they're looking to products such as Brainstorm Technologies' DataLink for Notes.

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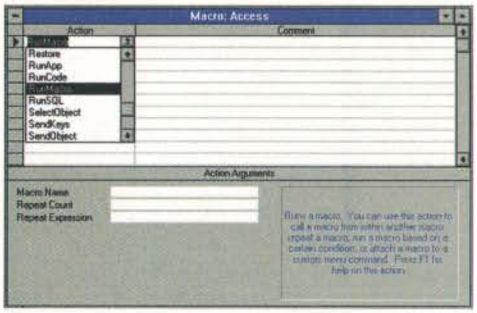
WINDOWS DATABASES

End-User Windows Databases Take Off

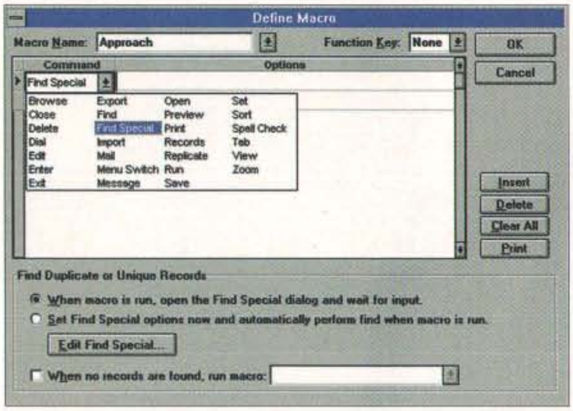
Software companies that develop Windows database tools for the corporate end user continue to refine their products' ease of use while building in room to extend to enterprise databases. Three Windows database offerings—Microsoft Access 2.0, Lotus Approach 3.0, and Alpha Software's Alpha Five for Windows—include tools, such as templates, tutorials, prompts, and help, that are designed to enhance out-of-box productivity. For many end users, this quick start is enough. Others, however, will want business applications that go beyond basic forms and reports; they require custom menus and icon bars, data-manipulation capability, and task automation. The best choice depends on an end user's particular skill level, unique style, and business requirements.



Access requires more database knowledge as tools get more advanced material.

Access 2.0 (see "Access 2.0: The Best of Both Worlds?," September 1994 BYTE) is packed with productivity tools: Wizards and Builders (42 in all, including interactive designers for tables, queries, forms, reports, and labels); ToolTips to help you decipher the user interface; Cue Cards to provide on-line tutorials (optionally with your own data); and a context-sensitive help system to provide help with anything that's visible on the screen. Access also includes many extended features for developing business applications, including a Menu Builder for developing customized menus.

Access 2.0 now includes the ability to interactively create application-specific icon bars. The program also includes a Macro Builder that automatically generates Access Basic code. Access readily imports or attaches to all the popular PC database files, automatically links to Word and Excel, supports OLE 2.0, and provides access to SQL data via its built-in ODBC driver. Microsoft also offers "upsizing tools" to simplify the conversion of Access data to client/server data on Microsoft SQL Server.



Macro Name: Approach
Function Key: None
Command: Find Special

Find Duplicate or Unique Records

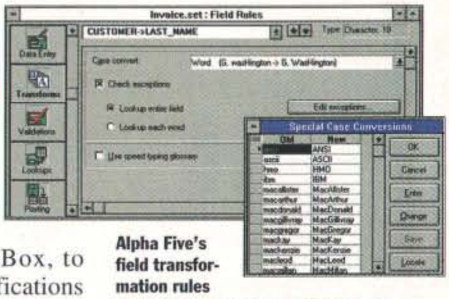
● When macro is run, open the Find Special dialog and wait for input.
○ Set Find Special options now and automatically perform find when macro is run.

☐ When no records are found, run macro:

Approach's interface to its macro language has an interactive dialog box that uses plain-English descriptions.

Approach 3.0 from Lotus ((617) 577-8500) boasts many of the same productivity tools as Access: Assistants with SmartMasters (including interactive designers for forms, reports, form letters, and mailing labels); SmartIcons; an on-line tutorial; and point-and-shoot context-sensitive help. Approach includes 51 templates and three sample applications.

Approach's Notetab interface makes moving between views in a database a snap. The program uses a context-sensitive standard interface, called an InfoBox, to make real-time modifications to every imaginable property in a view. Approach lets you customize the menus and icon bars without programming.



CUSTOMER->LAST_NAME
Type: Character 19
Case convert: Word (G. washington -> G. Washington)
☒ Check exceptions
● Lookup entire field
○ Lookup each word
☐ Use speed typing glossary

Old	New
[illegible]	ANSI
ascii	ASCII
hmo	HMO
ibm	IBM
macallister	MacAllister
macarthur	MacArthur
macdonald	MacDonald
macgillivray	MacGillivray
macgregor	MacGregor
mackay	MacKay
mackenzie	MacKenzie
macleod	MacLeod
macmillan	MacMillan

Alpha Five's field transformation rules exemplify the product's rich tool set.

Approach accomplishes every task interactively. It reads and writes all the popular PC database files; links automatically to 1-2-3 and Lotus Notes to analyze and share data and create reports, forms, worksheets, and labels; and supports OLE 2.0. The program transparently accesses SQL data sources either by using its PowerKey technology (for Oracle SQL, SQL Server, and DB2) or via its built-in ODBC driver.

Released in October, Alpha Five ((617) 229-2924) includes three basic Genies (database, query, and report designers), bubble help, and database-driven (as opposed to table-driven) default forms and reports.

The area where Alpha Five really shines is its rich feature set. In addition to a data dictionary (which offers the ability to set business rules at the database level), Alpha Five provides the most complete interactive tool set for business applications development. Although you cannot create custom menus in Alpha Five, you can turn off the speed bar, put speed-bar-style buttons on forms, and restrict menu items. When automating tasks, Alpha Five's script recorder captures every action and automatically generates xBASIC (a blend of BASIC and xBase) code; you can then view, modify, and reuse this code at will. Alpha Five also offers OLE 2.0 support and can natively read and write .DBF format. For the end user who can wait, Alpha Software plans to add ODBC data access in the first quarter of 1995 and bidirectional ODBC access by the summer.

—Jane Richter

END USERS DEFINED

The end user is someone who wants to accomplish business tasks without having to take the time to memorize manuals or master a programming language. An end-user database must be easy to use and contain a comprehensive, interactive (i.e., nonprogramming) feature set. The savvy end user evaluates a database on an ease-of-use scale that ranges from out-of-box productivity (easiest) to requiring substantial effort to arrive at a successful, uncompromising end of a task (hardest). —J. R.

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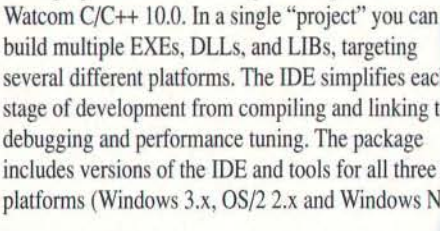
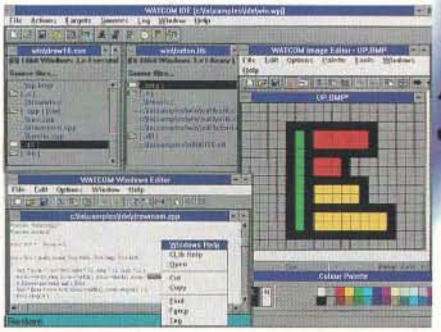


Watcom C/C++ 10.0 includes a source editor with syntax highlighting, a suite of resource editors, testing and monitoring tools for Windows 3.x and NT development.



The advanced multi-platform debugger accelerates the development cycle by increasing the bandwidth between you and your application.

Multiple Platforms in a Single Package Watcom C/C++ 10.0 supports development of applications targeting an incredible array of platforms: DOS, Windows 3.x, OS/2 1.x, 32-bit DOS (includes royalty-free DOS extender), OS/2 2.x, Windows NT, Win32s, 32-bit Windows 3.x and Novell NLMs. To maximize the potential on individual platforms, Watcom C/C++ 10.0 extends the capabilities of the core, multi-platform toolset with platform-specific tools, SDKs and libraries. This extensive support is amplified by the cross-platform capabilities of the IDE and tools, which enable building applications for a wide range of target environments from any of the host systems.

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Circle 124 on Inquiry Card.

STORAGE TECHNOLOGIES

15 MB in a Matchbook

SunDisk says its CompactFlash cards will deliver up to 15 MB of uncompressed storage for digital cameras, pagers, and other mobile devices.

The storage capacities of personal communications devices, pagers, and digital cameras could improve greatly in 1995, thanks to a 32-MB new flash-memory device, called CompactFlash, from SunDisk (Burlingame, CA). The CompactFlash, which the company says will be available in volume in the second quarter of this year, delivers from 2 to 15 MB of uncompressed capacity in a card that's the size of a matchbook (roughly one-quarter the size of a standard Type II PCMCIA card) and weighs just half an ounce.

CompactFlash cards will be available in 2-, 4-, 10-, and 15-MB capacities. In addition to combining the best elements of flash memory, the CompactFlash is compatible with the PCMCIA standard. That means you will be able to pull one of these tiny cards from your pager, PDA (personal digital assistant), or camera and put it in a CompactFlash PCMCIA Type II adapter card, which you then insert into your desktop computer, notebook, laser printer, or other device.

CompactFlash cards should make pagers and digital cameras more useful. Today's low-end cameras, such as the Apple QuickTake 100 24-bit digital device, typically have only enough on-board memory to store less than 10 high-resolution images. Alexis J. Gerard, editor of the *Future Image Report* (Burlingame, CA), says the low storage capacities of current low-end digital cameras means photographers working in the field have to download their images into a notebook computer if they want to take numerous high-resolution pictures. "CompactFlash," he says, "is the only thing that exists in such a small form factor that it offers electrical and logical compatibility with an established standard [PCMCIA]." CompactFlash cards could also allow two-way paging devices, a number of which should be introduced this year, to store large data messages, small fax messages, and even voice mail.

CompactFlash: Pro and Con

Pro
- Rugged (sustains a 10-foot drop to a concrete surface)
- Low power consumption
- Nonvolatile (i.e., retains contents when switched off)
- PCMCIA-compatible

Con
- Currently expensive

But one drawback is price. The volume price for CompactFlash devices to manufacturers will range from $75 (2 MB) to $345 (15 MB). But Nelson Chan, director of marketing at SunDisk, says prices will drop by about 30 percent a year. And he adds that flash RAM can be used repeatedly, unlike traditional film.

—Dave Andrews

WIRELESS TECHNOLOGIES

Infrared Gets Real

Although IR data links have long been possible, a lack of standards has resulted in incompatible technologies that have stymied IR connections' widespread adoption. But now the IRDA's (Infrared Data Association) new standard has vendors getting aboard the IR bandwagon.

The new IR standard lets you create links between systems up to 10 feet apart over IR serial connections at speeds of up to 115.2 Kbps. With these speeds (which are in the same ballpark as a floppy drive's throughput), convenience will be a big IR-device selling point. But the range restriction will keep IR data links that conform to this new standard out of LAN architectures. The IRDA is working on new standards that will overcome these restrictions and enable faster IR connections with greater range.

All this may lead you to believe that the current IR standard is destined to be a niche technology, but that isn't the case. Microsoft is supporting the IRDA standard in Windows 95, and hardware vendors are lining up to produce IR products.

Part of the reason for this is that IR technology is inexpensive. While no one's willing to talk pricing yet, all the vendors that BYTE interviewed were confident their products would be competitive with any other short-haul data transfer technologies, such as LapLink's (from Traveling Software) serial and parallel port cables.

Specifically, DEC's PC business (Acton, MA) was to release in the fall a new subnotebook called the Highnote Ultra, which will have an IR connection and data transfer software. Not to be outdone, DEC's old rival, IBM, will be releasing two IBM ThinkPad models, the 755CD and 755CE, with IR capacities. Other vendors will be introducing IR-capable PDAs (personal digital assistants). Apple, Motorola, and Sony have all thrown their hats into the IR-equipped-PDA ring.

And what will all these laptops and PDAs talk to? Possibly IR-equipped Hewlett-Packard LaserJets, according to HP. Adaptec is also moving aggressively in this area, with IR add-ons for OEMs and the after-sale market. Any way you look at it, it seems certain that IR technology is about to become an important part of the portable-computing world.

—Steven J. Vaughan-Nichols

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Andrew Wargo, Manager at Baxter Land Company, tried two other brands before Back-UPS. "One lasted a few days, a second one went up in smoke after 48 hours, a third lasted less than 24 hours! I then bought my Back-UPS for less than half of what I had paid for the others. We've purchased three more Back-UPS and for the past 14 months they've been just hummin' away on the same power line that was eating the other brands alive!"

If you're protecting a network server, a communications interface port (on models Back-UPS 400 and higher) provides the security of an automatic shutdown to all major OS including NetWare, Windows, Windows NT, LAN Server, LAN Manager, LANtastic, SCO Unix, OS/2, Banyan Vines, AppleShare/System7 and more, so your data is safe whether the system is attended or not. (PowerChute software and interface kits sold separately.)

And since data processed on networked clients needs protection too, the $139 Back-UPS 280 provides an economical solution for all your LAN workstations. And if you have a new green PC, the price is even better at $119 for the new Back-UPS 200.

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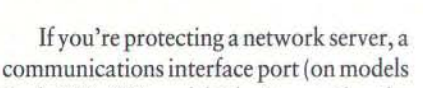

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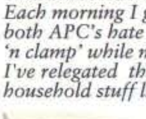
600	Heavily configured systems, CAD/ CAM workstations	$399
900	Multiple systems, longer runtime applications	$599
1250	Multiple systems, LAN hubs, small minis, telecom equipment	$799



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Dept. A2

VIDEO EDITING

Professional Video Prices Drop

Powerful desktop computers combined with new video-editing programs are delivering professional video-editing capabilities to the PC, Mac, and Power Mac platforms. These new video-editing programs with hardware can replace analog editing systems that can cost as much as $100,000.

Of particular note is Premiere 4.0 from Adobe, a professional-level program that can create and edit video, film, and CD-ROM movies. Premiere's status as either a replacement for—or a complement to—more expensive video-editing packages, such as Avid Technology's (Tewksbury, MA) turnkey Media Suite Pro and Data Translation's (Marlborough, MA) Media 100, will depend on your production needs, budget, and willingness to mix and match products and technical support from different vendors.

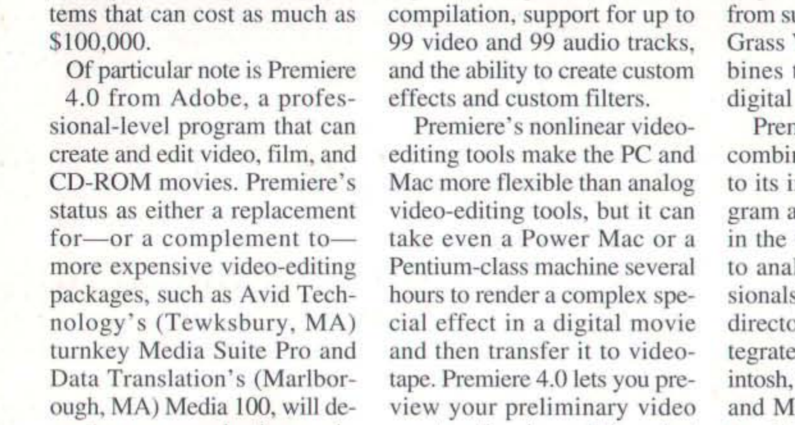
The Windows and Mac versions of Premiere 4.0 have many new features that will appeal to the video professional. Among these are support for SMPTE time code, movie capture and creation at the true NTSC rate of 29.97 frames per second, EDLs (Edit Decision Lists), batch digitization of analog video clips, batch movie compilation, support for up to 99 video and 99 audio tracks, and the ability to create custom effects and custom filters.

Premiere's nonlinear video-editing tools make the PC and Mac more flexible than analog video-editing tools, but it can take even a Power Mac or a Pentium-class machine several hours to render a complex special effect in a digital movie and then transfer it to videotape. Premiere 4.0 lets you preview your preliminary video construction in real time, but not the movie's special effects and transitions, which you still have to render.

Premiere 4.0's ability to read SMPTE time-code numbers lets you create an EDL that you take, along with your source videotapes, to a post-production studio. In the studio, the movie's various elements are combined to create a high-quality analog movie that you've already designed in Premiere. The package's support of the major industry EDL formats from such companies as CMX, Grass Valley, and Sony, combines the best of analog and digital editing.

Premiere's new capabilities, combined with improvements to its interface, make the program a formidable competitor in the video world, according to analysts and video professionals. However, some video directors will opt for more integrated products for the Macintosh, such as Media Suite Pro and Media 100, or Fast Electronic's (Redwood City, CA) Video Machine for the PC.

For example, Elizabeth Coker, who creates corporate training and other videos for Fortune 500 companies at the Tennessee Industrial Training Service, says she likes the approach that Avid takes with Media Suite Pro. Avid certifies its products' capture boards, specially modified Micropolis hard drives, sound boards, and SCSI-2 controllers to ensure the creation of high-resolution, frame-accurate videotape movies with synchronized audio and CD-quality sound. She also likes the fact that all her technical-support concerns are handled by just one company and that she can upgrade Media Suite Pro to Avid's top-level video-composing products.



Premiere 4.0 for Windows' support for EDLs, SMPTE time code, 99 video and 99 audio layers, and other features make it a contender in the professional world of desktop video production.

Avid says it will release a Windows version of Media Suite Pro early this year. Premiere's low price ($495 for the forthcoming Windows version; $795 for the Mac version) is attractive, but the program requires you to mix and match video-capture and audio-compression boards with high-performance, high-capacity hard drives.

Several video producers that we interviewed said that if you can afford it, you should get one of the higher-end products, such as Media Suite Pro. However, if you don't mind mixing, matching, and verifying different hardware and software components, Premiere 4.0 can deliver professional video less expensively. **—Jon Pepper**

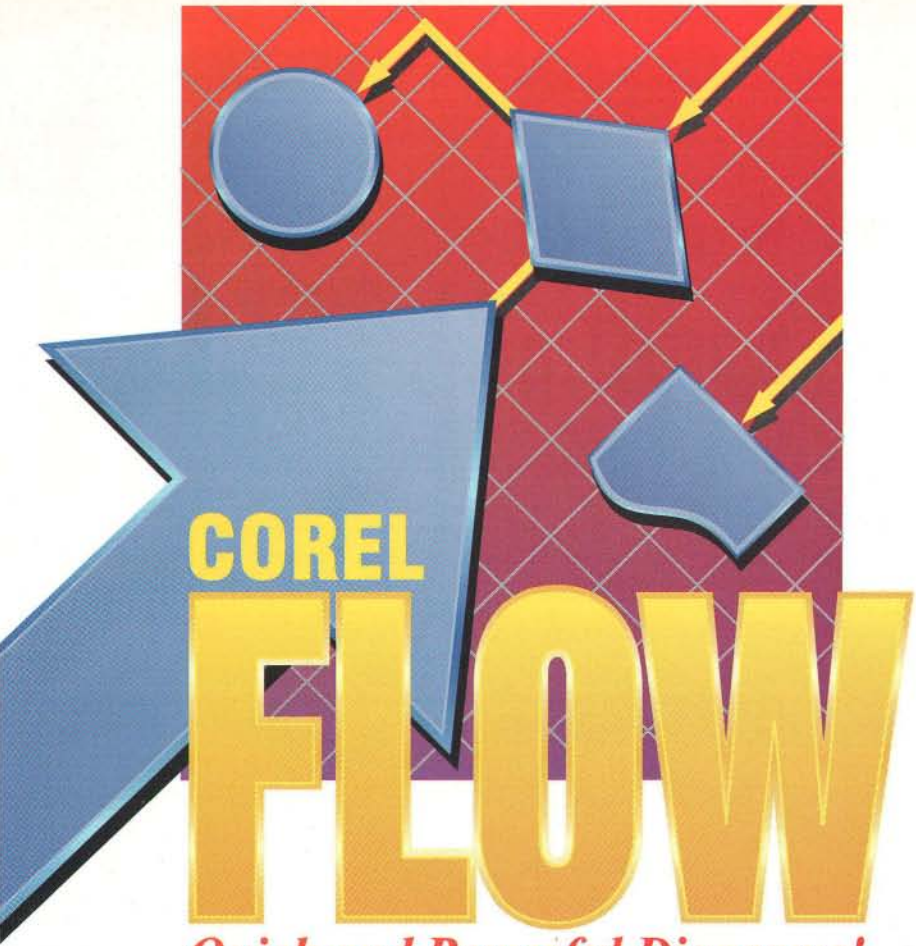
Contact Information

Media 100
Prices for this hardware/software digital-video package for creating broadcast-quality video on the Mac start at $8995.
Data Translation,
(508) 460-1600 ext. 100.

Media Suite Pro
This integrated digital-video editing system for the Mac (a Windows version is slated for spring) starts at $9995.
Avid Technology,
(800) 949-2843 or
(508) 460-1600.

Video Machine
Video Machine for the PC is a complete desktop video-editing suite ($3995); the $6995 Digital Player-Recorder add-on board offers simultaneous linear and nonlinear broadcast-quality-video editing.
Fast Electronic,
(415) 802-0772.

Adobe Premiere 4.0
The Mac/Power Mac version costs $795; the Windows version costs $495 through February 15, $695 thereafter.
Adobe,
(800) 833-6687 or
(415) 961-4400.



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ADAPTIVE COMPUTING

On-Line-Access Services Inconsistent for the Blind

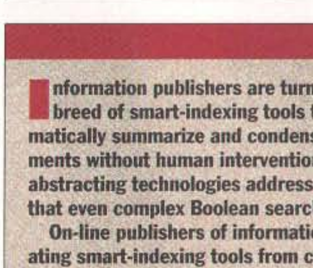
For more than a decade, the on-line world has been providing megabytes of information to thousands of blind computer users. Speech synthesizers, interfaced to personal computers, can read ASCII text as it scrolls onto a video monitor. But blind users' easy access to on-line information may be drying up as major providers, such as America Online and Prodigy, require users to have GUIs to access their on-line services.

GUI systems are typically difficult for the blind to operate, and few on-line-service providers seem to be aware that vision-impaired users may wind up as road kill on the information highway. For example, America Online is currently not user-friendly for visually impaired consumers who use Windows-based speech or braille-output systems, although the company says it is investigating remedies for this situation.

One solution to providing access is to construct GUIs that the blind can operate effectively; another is to offer parallel ASCII or GUI interfaces so that users can select the one that's best for them. Cyberia Communications (York, PA, data: (717) 840-1444; voice: (717) 840-0139) has chosen the latter route for its on-line service. The company offers subscribers a variety of services. When users log into Cyberia, for example, they can choose from three interfaces: normal emulation, graphical RIP (Remote Image Protocol) emulation, and Easy Access for the Blind emulation. When a user chooses the third interface, all graphics are stripped, and the menus are presented in a format that's easily readable by various screen-reading devices.

Other on-line services, such as BIX, CompuServe, Delphi, and GEnie, offer text interfaces that are suitable for the blind community. Vision-impaired users want to ensure that the ASCII option is kept open. "The trend toward the GUI is a disturbing development, because reliable access to these interfaces just isn't here yet," says Brian Charlson, senior computer instructor of adaptive equipment at the Carroll Center for the Blind (Newton, MA). "The blind are not against the development of the graphical user interface, but we are firmly against the development of any interface that doesn't work with speech, braille, or screen-magnification systems," he adds. The point is to produce a GUI that can work for both the sighted and the blind alike.

—Joseph J. Lazzaro



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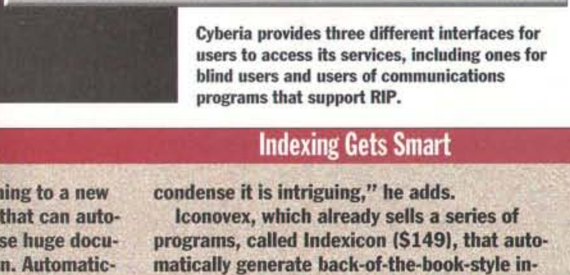


Cyberia provides three different interfaces for users to access its services, including ones for blind users and users of communications programs that support RIP.

Whatever Happened to . . . ?

The IMS 3250 (see "Make the Right CPU Move," December 1992 BYTE) For several years, International Meta Systems ((310) 375-4700) has been working on a RISC chip that can emulate x86 and 680x0 processors at competitive speeds. The company says the delays are partly due to a need to improve the chip's speech-processing capabilities. The 3250 will target the hand-held market and sell for about $80 in volume when it ships, which is slated for the middle of this year.

Indexing Gets Smart

Information publishers are turning to a new breed of smart-indexing tools that can automatically summarize and condense huge documents without human intervention. Automatic-abstracting technologies address problems that even complex Boolean searches can't.

On-line publishers of information are evaluating smart-indexing tools from companies such as Iconovex (Bloomington, MN, (612) 943-0292) and InText Systems (Folsom, CA, (415) 391-5290) so that content subscribers won't waste time needlessly downloading large documents. "A lot of times, full-text indexes provide a lot more information than people can use," says Tom Mandt, director of advanced development at IVI Publishing (Minneapolis, MN), a digital publisher that's expanding its on-line presence. "The ability of these tools to look at a lot of information and condense it is intriguing," he adds.

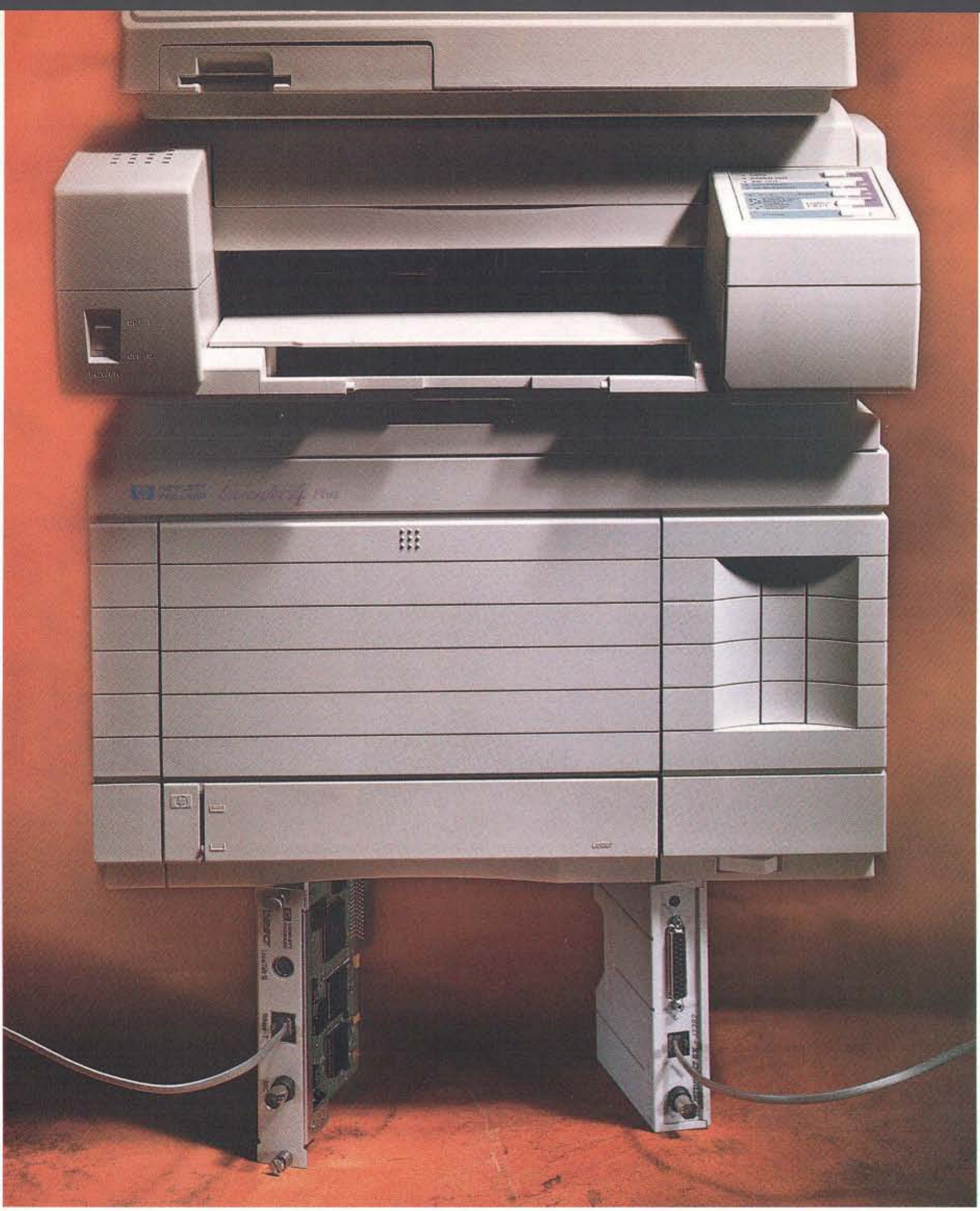
Iconovex, which already sells a series of programs, called Indexicon ($149), that automatically generate back-of-the-book-style indexes for popular Windows and Mac word processors, has developed a toolkit for C and C++ programmers, called Syntactica. Available now for Windows, and soon for Unix and the Mac, Syntactica can generate an indicative abstract (i.e., a summary of the full text) by using a combination of semantic and syntactic analysis. In addition to creating traditional back-of-the-book indexes, the toolkit can create concept indexes, in which a document's key ideas are provided both alphabetically and by page number.

Another intriguing development comes from InText Systems. The company is currently developing a software development kit for on-line publishers to use in writing agent programs that let users launch searches through World Wide Web documents. The agents create abstracts of documents that meet a specific search criterion.

Another company using smart-indexing technologies to summarize text is Oracle (Redwood Shores, CA, (415) 506-7000), which says it will integrate its ConText linguistic-analysis and content-extraction software into its Documents workgroup software for managing unstructured text data.

"The whole idea of the intelligent document is gaining acceptance," says Carl Frappaolo, executive vice president at Delphi Consulting (Boston, MA), a consultancy specializing in electronic-document management. "Smart-indexing tools are the next big thing in this area."

—D. A.



The BEST of TIMES 1994 LAN TIMES

JetDirect EX External print servers support any parallel-based printer. JetDirect cards support HP LaserJet, HP DeskJet and HP DesignJet printers with I/O slots

NOS compatibility: Novell NetWare; IBM LAN Server; Microsoft LAN Manager; Apple EtherTalk; Apple LocalTalk*; Windows NT; Windows for Workgroups; UNIX: HP-UX, SunOS, Solaris, IBM AIX, SCO UNIX, lpd**

Network compatibility: Ethernet: 10Base-T, 10Base2; Token Ring (4/16 Mbps); Apple LocalTalk*

Multiple protocols with automatic switching

Software management utilities such as HP JetAdmin and HP JetPrint†† for NetWare and UNIX for easy printer installation, remote status and management

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NEC NEWSCOPE

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Our Versa V Series offers outstanding notebook performance and TFT color screens at an affordable price. We have four models with DX2 50MHz CPUs, 4MB system memory and up to 340MB of disk storage. The Versa V Series features DoubleTime™ technology with a second battery for 6 to 10 hours of on-the-road computing. Back at the office, the Versa V becomes a full-featured desktop PC with our Docking Station™ II.

The Versa S Series is designed especially for those who need to travel light. Our high-end, 9.5-inch TFT color model with 260MB hard disk weighs only 2.3kg. It measures 276(W) x 212(D) x 42(H)mm. Five models are available with SX 33MHz or DX2 50MHz CPUs, and 4MB RAM.

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C&C for Human Potential

Updates on the scope and depth of NEC technologies

Number 154

PROMOTING SDH NETWORKS WORLDWIDE

Network providers around the world are rapidly introducing digital networks based on the Synchronous Digital Hierarchy. NEC offers a comprehensive line of SDH fiber optic transmission systems and microwave radio systems. We are working with network providers in many countries to plan and implement optimum SDH networks.

NEC has started delivery of 155-Mbps SDH microwave radio equipment for the Novosibirsk-Khabarovsk link spanning 4,500km in Russia. The link is part of the grand Europe-to-Far East network connecting Copenhagen, St. Petersburg, Moscow and Khabarovsk. NEC SDH microwave systems will also be used in trunk routes extending 2,000km in Sweden.

Recent orders for our SDH fiber optic transmission systems (FOTS) have come from network providers in Brazil and Mexico, and the national railway of China. Our FOTS will be a nerve center in a trunk line of the projected 2,500km railway between Beijing, China and Kowloon, Hong Kong.

In the US, a leading long-distance carrier has chosen our 2.4Gbps SONET FOTS to connect major American cities. NEC will also supply FOTS and advanced network management systems to a regional Bell company.

P7 OFFERS 40 HOURS OF STANDBY TIME

Our new P7 cellular phone is optimized for business users who demand a whole day's service and don't want to carry spare batteries around.

The P7 offers 40 hours of standby and 135 minutes of talk time with a standard battery. It gives users an extra margin of security and eliminates power problems around the clock.

The P7 offers all the essential functions of a high-end cellular phone. It fits snugly in your palm and weighs only 250g. It's easy to use. It has a 40-character, 4-line LCD screen. Both the display and key pads are illuminated for nighttime use.

Speech is loud and clear. The P7 has a microphone which filters out peripheral noise and a concave earpiece that lets you hear the caller, not the passing traffic. A retractable, flexible antenna ensures excellent reception.

You can easily convert the P7 to a car phone with optional car kits. They include a cigarette-lighter adapter, a hands-free kit and a 3W booster.

SMART, COST-EFFECTIVE PABX

The NEAX7400 ICS* series is a new generation of PABX systems for voice and data. It features a unique architecture – distributed access to a cluster of telephones.

Conventional PABX systems make direct access to each telephone they serve. This requires as many connecting cables as telephone sets. NEC's new system uses only two pair cables. They carry 2Mbps of multiplexed data for connection with a Distributed Access Unit. The DAU provides information for up to 30 telephones.

Distributed access greatly reduces cabling costs and duct-space requirements. Users can add or move telephones with unprecedented ease. The DAU system offers an efficient response to the needs of work groups by connecting clusters of analog or digital telephones.

Our new PABX systems come in a variety of modular, upgradeable models supporting up to 23,552 ports. All offer over 500 service features, including integration with computers and access to ISDN.

*Names/specs vary in Brazil and the USA.

NEC

INTERNET COMMERCE

The Next On-Line Wave

On-line services are responding to users' enormous demand for Internet accessibility by incorporating Internet access and tools as fast as their engineers can bring the connections on-line. As a result, Delphi ((617) 491-3393) has proclaimed a new identity: Delphi Internet Services. America Online ((703) 448-8700) recently announced it has become the most popular Internet service provider. And, by the time you read this article, CompuServe ((614) 457-8600) should be letting its commercial customers connect to the Internet via its Frame-Net frame-relay service.

But in addition to heightened interest in Internet access, Internet users also want to access on-line services, these companies say. CompuServe, for example, which already offers E-mail, access to Usenet newsgroups, FTP, and, by early next year, full Telenet services, also has a home page on the WWW (World Wide Web) (see HTTP://www.compuserve.com) to inform Internet users about its services. The company says it will sell WWW services to other companies early this year.

CompuServe won't disclose what its precise plans are, but the company may possibly be working on a combined interface to both CompuServe Information Services and the Internet. Such a front end would combine a Mosaic-like WWW viewer with the functionality of its CIM (CompuServe Information Manager) family of front ends.

AOL also plans to install a WWW server that will let Internet users access portions of AOL for free as well as download AOL software and membership kits. Because the newest version of AOL's end-user software lets you use its Windows and Mac front ends with Telenet connections to access AOL, this approach may prove quite successful.

Delphi is being the most coy about disclosing its plans for the future. At press time, Delphi, which was the first major on-line service to offer a wide variety of Internet services, would only admit that 1995 will see a multimedia Delphi interface that will provide users with full access to all Internet tools, including the WWW.

Prodigy ((914) 448-8000) and GEnie ((301) 340-4000) lag behind the others in the Internet feature race. Prodigy only recently added Usenet newsgroups to its array of wares. GEnie will offer a full plate of Internet services by the beginning of this year, including FTP, Gopher, WAIS (Wide Area Information Service), and outbound Telenet.

Prodigy, however, after being the least Internet-friendly on-line service for years, is coming on strong. In November it launched AstraNet, an independent on-line service based around WWW servers. AstraNet, which is located at www.astranet.com, will include information provided by the current Prodigy team and other companies. Prodigy says it will release its own WWW browser this year.

As the on-line traffic increases, engineers working at on-line services may find their systems stretched to capacity. In times of failure, users who have come to rely on these services for their business will become impatient, much as they did when CompuServe experienced difficulty with its E-mail last November. **—S. J. V.-N.**

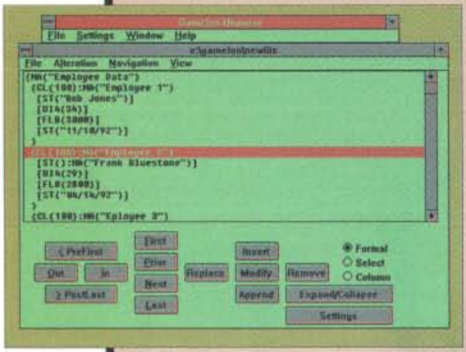
CODE TALK

RICK GREHAN

File I/O on Objects, Instead of Bytes

The word *Gamelon* sounds like it should be the name of Godzilla's archrival. Instead, it's the name of an object-oriented file access library for OS/2, Windows, and Windows NT that could probably get away with calling itself a full-fledged object-oriented database engine.

Gamelon, which is available from Menai (Menlo Park, CA, (415) 853-6450) views a file as a collection of objects. Consequently, your program doesn't maneuver through a file by telling Gamelon something like, "Advance the file pointer 400 bytes and read 12 bytes." Instead, the call looks more like, "Advance the file pointer three objects into the file and read the following object." Those three objects could be literally anything. That's the beauty of Gamelon.



```
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  [ST("Bob Jones")]
  [UI4(34)]
  [FL8(3000)]
  [ST("11/10/92")]
 }
 {CL(100):NA("Employee 2")
  [ST():NA("Frank Bluestone")]
  [UI4(29)]
  [FL8(2800)]
  [ST("04/14/92")]
 }
 {CL(100):NA("Eployee 3")
```

Gamelon's browser is a worthwhile utility.

Objects that can be found within a Gamelon file fall broadly into one of two categories: data objects and aggregate objects. A *data object* is a simple object—it can be an integer, a floating-point number, or a string. However, the word *simple* might be misleading; a data object could also be a BLOB or a data structure (in the sense of a C `struct()` data type). An *aggregate object* is an object container that holds simple objects and/or other aggregate objects.

Gamelon's equivalent of a file pointer is a *cursor*, a kind of roving pointer that keeps track of the object in the file that your program is currently accessing. Unlike a simple file pointer, a cursor can point at an aggregate object as easily as it can point at a data object. Consequently, manipulating aggregate objects is as simple as manipulating data objects. If you move the cursor to an aggregate object (that contains, say, 400 other objects) and issue Gamelon's equivalent of a `delete()` function call, the entire aggregate object—members and all—is gone.

The NT version of the Gamelon library ($495) arrives as a collection of header files, a .DEF file, a DLL, and utilities. The files provide all the linkage you need to hook your program into the DLL (where Gamelon lives), so adding Gamelon to your program is really just a matter of placing the proper files into your project. Currently, Gamelon provides interfaces for C and C++. Gamelon is thread-safe, so you'll have no problems running it from a multithreaded program.

I found the browser to be the most worthwhile utility included. It allows you to explore existing Gamelon data files as well as create new ones. The browser also lets you manipulate simple and aggregate objects; you can insert, delete, and modify them, as well as move the cursor through a file either by clicking on navigation buttons or by simply pointing to the object you want to focus on and clicking the mouse. This is handy for making sure that your Gamelon-based programs create the file structures that you intended them to create.

Gamelon even provides locking and transactioning. Possibly the only thing keeping it from being an object-oriented DBMS is the lack of an indexing capability.

Blasts from the Past

DENNIS BARKER

As we approach our twentieth year of publishing BYTE, we'll be looking back at highlights from two decades of covering the PC revolution.

5 Years Ago in BYTE

Second annual BYTE Awards. Things we thought excellent from '89 included the 486, for which we made the daring prediction: "we see great potential"; Apple's 32-bit QuickDraw; Xircom's Pocket Ethernet Adapter; Wingz; OSF Motif; the Texas Instruments Graphics Architecture; Phar Lap's Virtual Control Program Interface; and Electronic Arts' Studio/1 paint program. Only one computer made the best-of-the-year list: the Mac IIci — "the biggest jump in processing performance for a Mac since the Mac II was announced."

Strange Little Beastie of the Month
The Portable Mainframe from Opus Systems: a $14,000 386SX-based lunchbox with a Motorola 88000 card slotted in. The 88K zoomed along at 21 MIPS, but because the thing was plugged into an AT slot, throughput was throttled. Good for running big spreadsheets, but not for conducting experiments in fluid dynamics in your hotel room.

The Next Cube had been announced more than a year before, but it wasn't until mid-'89 that we actually could get a production machine for testing, and then a few more months to get a less buggy operating system. As a concept, we liked Mr. Jobs's onyx box, especially the software and development tools, "but the cube doesn't make it as a multiuser Unix system." Man, are we glad we didn't call it "insanely great."

Microsoft and IBM, hoping to make everything perfectly clear, called a press conference to define their operating system intentions. Windows would be tailored for PCs with less than 2 MB of RAM, said IBM's Jim Cannavino. OS/2 1.2 would be for 3-MB machines, said Microsoft's Bill Gates, and OS/2 2.0 would be for luxury systems. According to Cannavino, Windows would never be a server platform, and it would never have the fancy features of OS/2, like multithreading, distributed processing, and long filenames.

10 Years Ago in BYTE

You can tell now that the preceding year had been the Year of the Mac Debut. This issue was full of Mac-related articles, including features on Microsoft Mac BASIC version 2 and "The Visual Mind and the Macintosh," which extolled MacPaint as a tool for visual thinking.

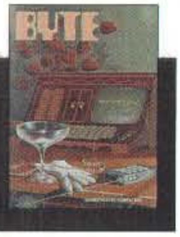
From the UK

Dick Pountain reported on the Amstrad CPC 464. Amstrad targeted its new Z80A-based system for use in the home, where most computers were used for "playing games or learning programming." The CPC 464, with its 80-column screen, "neat" operating system from Locomotive, and support for CP/M and DOS, appeared to be a business and a pleasure machine. With a color monitor, it sold for £375 — a deal, considering color monitors sold then for about £300.

We interviewed Steve Wozniak. The Woz spoke candidly about mistakes Apple had made with the Apple III. "We made it very difficult for anyone to get access to the insides of the machine. . . . We closed that machine up to where somebody could have a very difficult time finding out how to add their own I/O drivers. . . . We made it very difficult for outside developers instead of providing all the information as we did with the Apple II." Some folks are still using Apple IIs. When was the last time you saw someone using an Apple III?

Our West Coast bureau reported from Unix Systems Expo, in L.A., that Unix was starting to appear on PCs. Amidst all the minicomputer products, Xenix was running on IBM PCs, Tandy Model 16Bs, and Apple Lisas. Our reporter lamented the preferential treatment given attendees of a men's fashion show going on at the same time. The fashion people got free parking at the convention center and free passes to the Unix show. The Unix crowd didn't.

15 Years Ago in BYTE



Domesticated computers. Along with Steve Ciarcia's instructions on building a home-control console, we explained how you could use a microcomputer to manipulate the lighting in your house, run the furnace, dial the phone, and sustain marital bliss (No, wait — *sustain marital bliss* is in an upcoming issue).

> "As of this writing, the state of the art in personal computing is such that the user is king. It is possible to enter a computer store and witness the operation of a typical modern system, try it out, then purchase one just like it to take home."
>
> — Carl Helmers editorial, "The Era of Off-the-Shelf Personal Computers Has Arrived"

Time was more expensive then. Mountain Hardware advertised its Apple Clock, for the Apple II. It kept time in 1-ms increments and came with software for calendar and clock routines. But the board cost $199, and it took up a whole slot.

Programming quickies included listings for a checkbook balancer written in Pascal and a program in CBASIC that would give you the French equivalent of an English word and vice versa.

Intrdcng *th* wrld's fstst md-rnge wrkstns.

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Enclosure	Desktop	Desktop	Mini-tower
Chip Speed	166MHz	233MHz	233MHz
SPECint92	107.7	157.7	157.7
SPECfp92	134.8	183.9	183.9
Xmark93	11.93	15.04	15.04
I/O Slots	2 PCI/ISA 1 ISA	2 PCI/ISA 1 ISA	2 PCI 3 ISA, 1PCI/ISA
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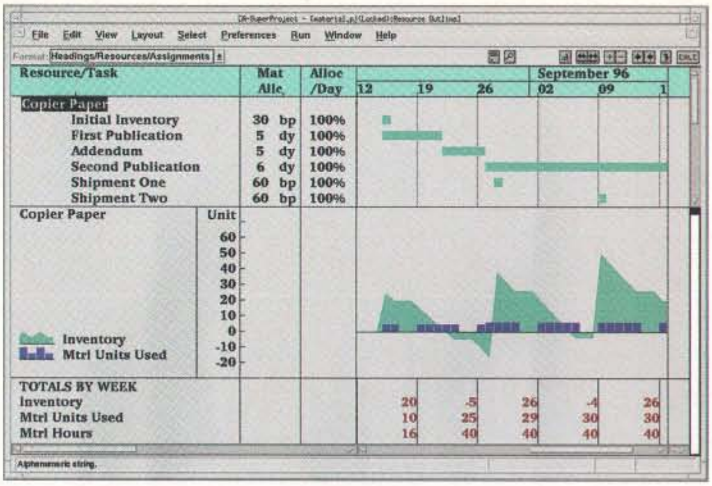
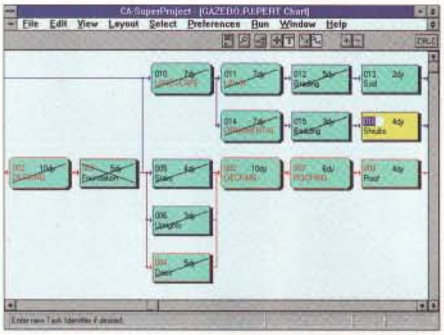

File Edit View Layout Select Preferences Run Window Help
Format: Headings/Resources/Assignments
Copier Paper
Inventory
Mtrl Units Used
Alphanumeric string.

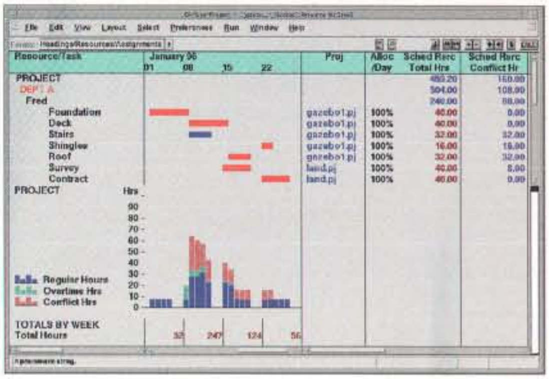
Resource/Task	Mat Allc	Alloc /Day
Initial Inventory	30 bp	100%
First Publication	5 dy	100%
Addendum	5 dy	100%
Second Publication	6 dy	100%
Shipment One	60 bp	100%
Shipment Two	60 bp	100%

TOTALS BY WEEK					
Inventory	20	-5	26	-4	26
Mtrl Units Used	10	25	29	30	30
Mtrl Hours	16	40	40	40	40

Track and manage the production, inventory and use of materials in addition to the management of labor, equipment and other resources.


CA-SuperProject - [GAZEBO.PJ:PERT Chart]
File Edit View Layout Select Preferences Run Window Help
Enter new Task Identifier if desired.

Change project views to see WBS or PERT charts showing dependency links, milestones and status.


File Edit View Layout Select Preferences Run Window Help
Format: Headings/Resources/Assignments
January 96
Hrs
Regular Hours
Overtime Hrs
Conflict Hrs

Resource/Task	Proj	Alloc /Day	Sched Rsrc Total Hrs	Sched Rsrc Conflict Hr
PROJECT			480.20	160.00
DEPT A			504.00	108.00
Fred			240.00	88.00
Foundation	gazebo1.pj	100%	40.00	0.00
Deck	gazebo1.pj	100%	40.00	0.00
Stairs	gazebo1.pj	100%	32.00	32.00
Shingles	gazebo1.pj	100%	16.00	16.00
Roof	gazebo1.pj	100%	32.00	32.00
Survey	land.pj	100%	40.00	8.00
Contract	land.pj	100%	40.00	0.00

TOTALS BY WEEK				
Total Hours	32	247	124	56

View project status quickly and easily to anticipate and avoid costly project delays.

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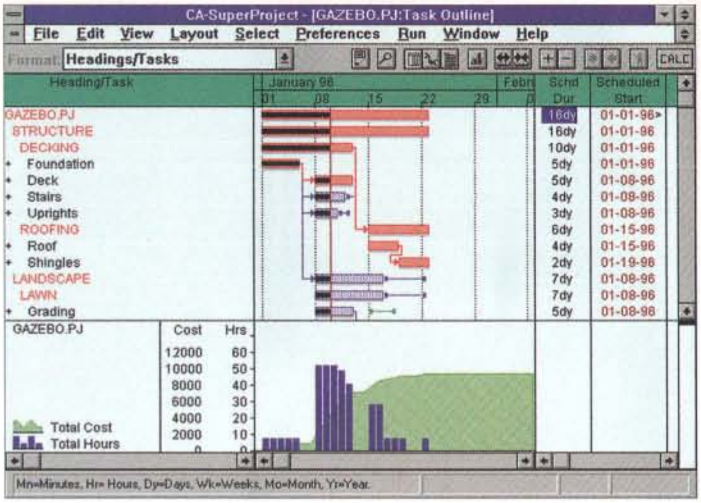
CA-SuperProject - [GAZEBO.PJ:Task Outline]
File Edit View Layout Select Preferences Run Window Help
Format: Headings/Tasks
January 96
Febr
GAZEBO.PJ
Cost
Hrs
Total Cost
Total Hours
Mn=Minutes, Hr= Hours, Dy=Days, Wk=Weeks, Mo=Month, Yr=Year.

Heading/Task	Schd Dur	Scheduled Start
GAZEBO.PJ	16dy	01-01-96>
STRUCTURE	16dy	01-01-96
DECKING	10dy	01-01-96
Foundation	5dy	01-01-96
Deck	5dy	01-08-96
Stairs	4dy	01-08-96
Uprights	3dy	01-08-96
ROOFING	6dy	01-15-96
Roof	4dy	01-15-96
Shingles	2dy	01-19-96
LANDSCAPE	7dy	01-08-96
LAWN	7dy	01-08-96
Grading	5dy	01-08-96

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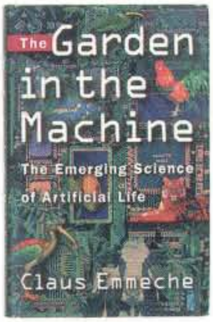
The Garden in the Machine
The Emerging Science of Artificial Life
Claus Emmeche

Creating Life in a Computer

ANDREW SINGLETON

Artificial life (AL) burst on the scene as a science, a technology, a philosophy, and a group of personalities during the first AL conference in 1987. Now, with Claus Emmeche's book *The Garden in the Machine*, we have a concise guide to all the various threads, tied together with Emmeche's own philosophical analysis.

AL researchers explore "the biology of the possible." They believe that we can use computers to explore the world not of BL (biological life) but of many possible alternative life-forms. They define life not by its material substance but by its organization, which can include the patterns of information in a computer. The researchers believe life in all its forms has mechanisms for processing energy and information that emerge from some fundamental order in the universe, a new natural law that shapes those forms out of chaos.

If life can have alternate forms, what is life? With that question, we plunge into the zoology of AL, including its history, its technologies, and its personalities, all in only 166 pages. We learn about exobiology, biochips, artificial chemistry, genetic algorithms, animats, cellular automata, computational ecology and thermodynamics, the edge of chaos, and the riddle of morphogenesis.

The history lesson begins with Aristotle, who proposed "psyche," the force that gives animals independent motivations, and continues through John von Neumann, who drew up a detailed plan for a "self-reproducing automaton." Emmeche introduces biologists such as Louis-Jean-Marie Daubenton, C. H. Waddington, and Jay Gould. We meet Tom Ray, creator of evolving AL creatures, and Christopher G. Langton, the organizational father of AL, author of the "seven commandments" of AL, and originator of the "edge of chaos" theory of computation.

We see the influence of Stephen Wolfram, who explored the space of cellular automata, and Edward Fredkin, who believes the universe is a cellular automaton. We get a quick explanation of the evidence behind Stuart Kauffman's claim to have found mathematical principles for the organization of life, and an even quicker review of John H. Holland's genetic algorithms.

This book does not require a knowledge of computer science. The description of cellular automata and the game of Life recounts how John Conway's first experiments involved moving dishes around on his floor tiles. To his infinite credit, Emmeche does not oversimplify the science or the philosophy that he is describing, and his paraphrase of technical points is accurate.

Emmeche writes that AL research is a shadow world that exists mostly in theories. They won't bring forth a slimy snail or a nightingale. As a biologist, Emmeche has come to terms with the capabilities and limitations of AL in relation to his chosen field. But he stops short of exploring the larger cultural and ethical implications of AL.

AL imitating BL relies on bottom-up evolution. BL starts with relatively simple organisms and builds more complex behavior through evolution and emergence. This principle, applied to the creation of AI, is the motivation for genetic programming. Starting with thousands of simple, randomly generated programs, genetic programmers attempt to cull out the ones with useful behavior. They

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(Maris Multimedia, Ltd., London, U.K.,) $69.95

As "the ultimate encyclopedia of military aircraft and aviation" for the 1976–1994 period, this CD-ROM doesn't quite live up to its billing. For those in love with planes, however, it's a good start. The disc has aircraft and weapons data, a history section, a three-plane flight simulator, and coverage of many conflicts.

Planes are the heart of this CD—530 aircraft from around the world, most with photos and about 20 percent with video clips. There is reasonably complete information on each plane's history and specifications, but the photos (a maximum of two per plane) are disappointing. Often, you can't tell what the plane really looks like. There are no photos for several far-from-secret aircraft, such as the F-16XL. It appears the publisher assembled these pictures hurriedly, without much attempt to select good images.

The video clips, displayed in a 2- by 3-inch window on a 14-inch monitor, show mostly takeoffs. Image quality is fair. Overall, the video adds little value.

The flight simulator lets you "pilot" a Russian SU-27 fighter, a C-130 Hercules transport, and an A-10 Warthog ground attack plane. It's poorly documented, and some controls seem backward—left-arrow key to bank right, and vice versa.

The conflicts section cross-references planes, airfields, and so on for the cold war in Europe, the Arab-Israeli conflict, and the Gulf War (U.S. Navy and joint RAF/coalition operations). Its history feature shows a shadowy map; when you click an on-screen button, event captions appear in chronological order, with lines to show where they occurred. When the screen gets full, it clears and moves to the next time period. It's not very interesting or informative.

All in all, this disc tries to cover too much ground. Limited to plane facts, with better photos, would have made this a treasure trove for the aircraft enthusiast. As it is, it's a reasonably in-depth reference on many planes and weapons. *—Russell Kay*

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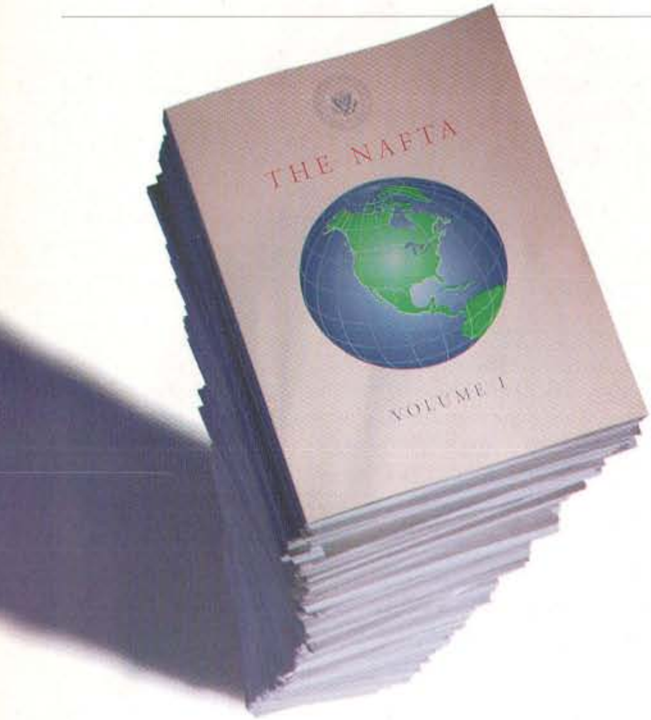

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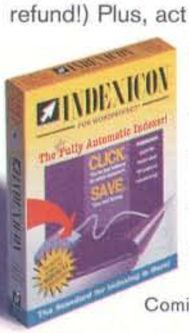
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apply a genetic algorithm to select the best candidates, modify them with mutation and crossover (or mating), and create a new population of candidates. A refined version of this process might build up software with powerful capabilities. At the very least, we know that a similar mechanism can yield surprising results in the realm of BL.

Where philosophers blaze a trail, engineers follow with paving equipment, and nobody has heavier machinery than John R. Koza. His book *Genetic Programming* weighs in at 800 pages and contains data from hundreds of experiments. Each experiment required runs from several hours to several days on an aging Lisp machine and includes its own statistical charts.

The book contains an introduction to genetic algorithms and a thorough explanation of the mechanism for applying a genetic algorithm to generate S-expressions or Lisp expressions. The appendix contains the complete listing in Lisp code of a simple genetic-programming system and several other tools. The reference material is complete enough to teach you how to do genetic programming and reproduce many of the experiments.

Koza is a pioneer in the field of genetic programming, and he has faced a number of skeptics. The idea of randomly combining computer routines does sound crazy to anyone who has faced the difficulty of debugging even a carefully constructed routine. His book includes a sometimes plodding attempt to justify genetic programming as a systematic and widely applicable method.

The book starts with two claims. One, that many problems can be cast "as requiring the discovery of a program that produces some desired output when presented with particular inputs," or program induction. Two, that genetic programming is an effective way to do program induction. The book then presents a wide variety of problems and demonstrates how to set them up as program-induction problems. In finding and setting up these problems, Koza shows real ingenuity.

He solves classic control problems, such as cart balancing, and introduces diversions like the optimal feeding strategy for a

THE GARDEN IN THE MACHINE
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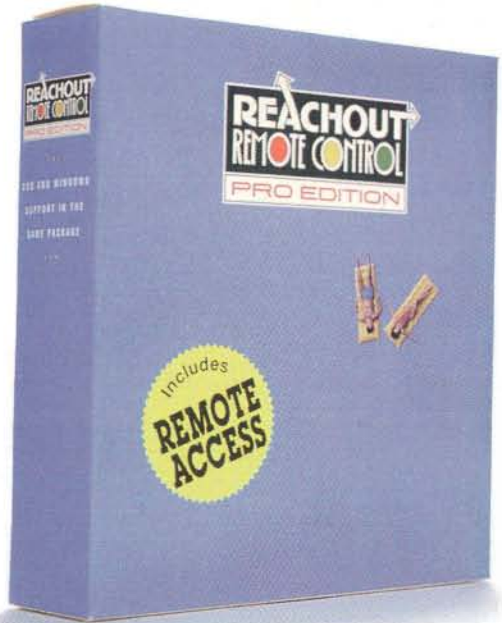

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lizard. Through this all, it is apparent that genetic programming can solve only simplified problems. In an attempt to solve more difficult and more realistic problems, Koza introduces the idea of Automatically Defined Functions, or ADFs. These are evolved subroutines, which add a more complex, hierarchical structure to the evolved programs. ADFs are the subject of a second weighty tome entitled *Genetic Programming 2*.

It explores the application of ADFs in chapters such as "The Bumblebee Problem" and "Prediction of Omega Loops in Proteins." It examines how ADFs perform as problems get harder. It shows how you can force ADFs to take on specialized functions and exploit this specialization. It looks at ADFs with fixed arguments, with no arguments, and with an evolved number of arguments. The book demonstrates that ADFs bring more difficult problems within reach, although it leaves open the question of how genetic programming can be scaled up to produce, for instance, a machine-vision system.

For all their depth, Koza's books are extremely narrow. They present only one particular mechanism for doing genetic programming. A few of Koza's conclusions, like the one that mutation is not useful, are wrong. A more expansive view of genetic programming comes from Kenneth L. Kinnear's *Advances in Genetic Programming*. This anthology of papers from 22 contributors shows off the exuberance of the new field.

Advances in Genetic Programming contains useful work on theory, representations, and applications. Kinnear compares ADFs to other methods for building hierarchy. Eric Teller shows how genetic programming can evolve the use of memory, or "mental models." Frederick Gruau demonstrates how genetic programming can be applied to generate embryos that expand into neural networks. Peter Nordin applies a genetic algorithm to generate superfast machine-language programs rather than Lisp. The book also contains examples of truly practical genetic-programming applications. Brij Masand used genetic programming to optimize text classification, and Howard Oakley used it to produce a useful stack filter for measuring blood flow. Several authors present approaches to image recognition.

Even if you never have the patience to read academic conference proceedings, you should read *Artificial Life II*, the proceedings of the second conference on AL held in Santa Fe in 1989. It contains a remarkable concentration of influential and broadminded writing. Christopher Langton examines the conditions that lead to interesting behavior (here called "extended transients") in cellular automata and, by implication, in the crucibles of AL and evolution. Thinking Machines founder W. Daniel Hillis adds to the practice of artificial evolution with the technique of "Co-Evolving Parasites." And Robert J. Collins and David R. Jefferson describe their "Ant Farm" experiments in simulated evolution.

You too can get involved. A practical background for those excited about genetic programming begins with David E. Goldberg's textbook *Genetic Algorithms in Search, Optimization, and Machine Learning*. The two *Genetic Algorithms* books suggest some of the several ways that genetic algorithms can be applied. Internet mailing lists and newsgroups track the current action. ■

Andrew Singleton is president of Creation Mechanics (Dublin, NH), a software development company specializing in genetic programming for financial analysis. You can reach him on the Internet or BIX at editors@bix.com or at p0039@psilink.com.

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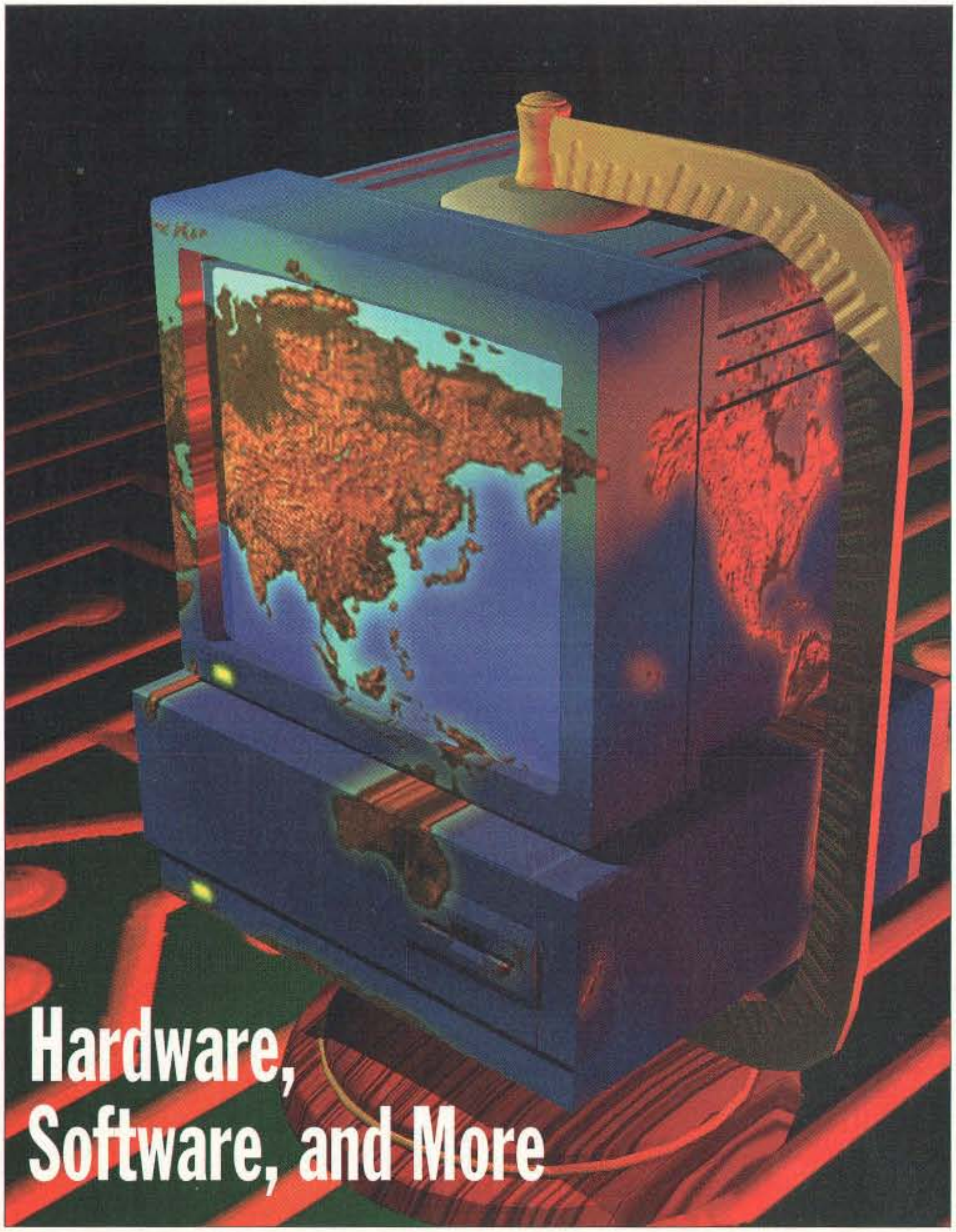

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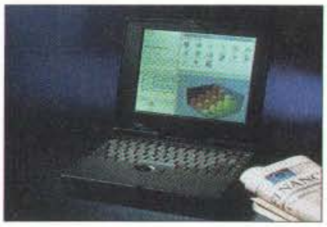

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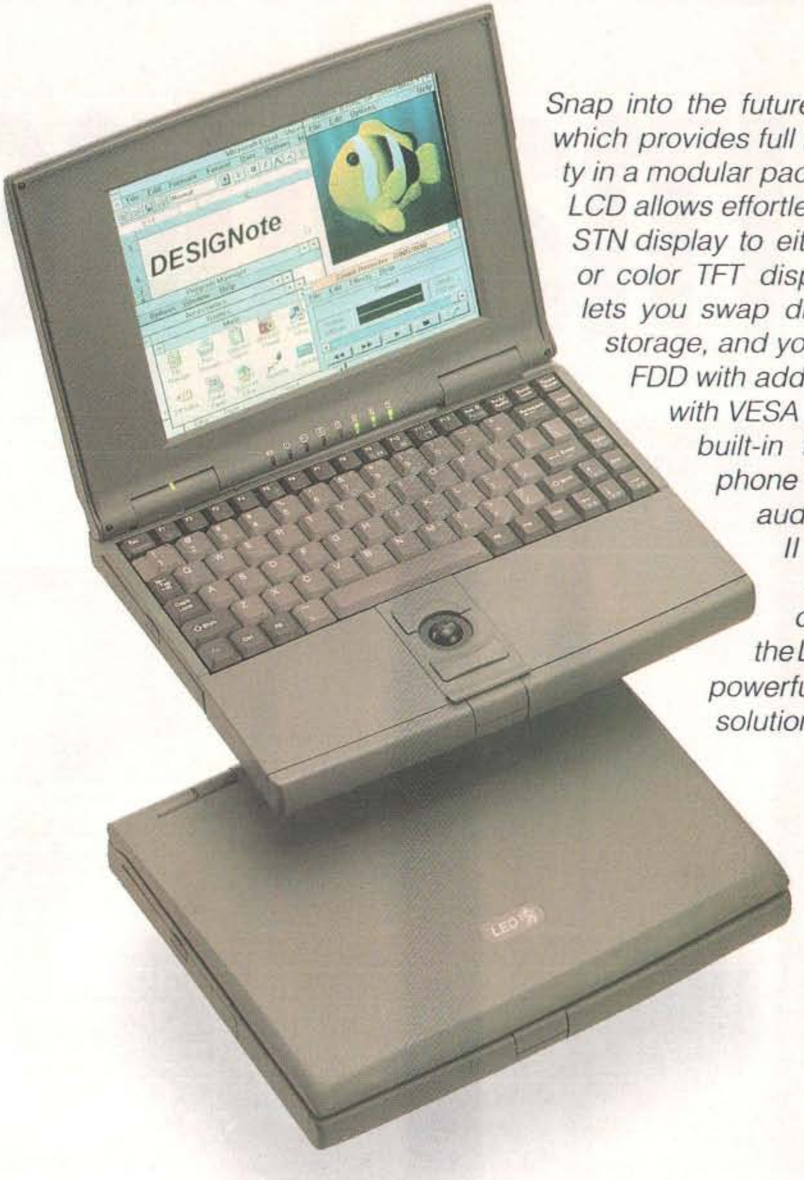

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You can configure the 5500 system (per channel, £820) to provide individual analog outputs, digital outputs, or both. In analog form, either continuous or multiplexed, the level is ±10 V full scale. In digital mode, the 5500 system uses a sample-and-hold amplifier and an ADC for each channel operating at a digitizing rate of 50,000 samples per second.
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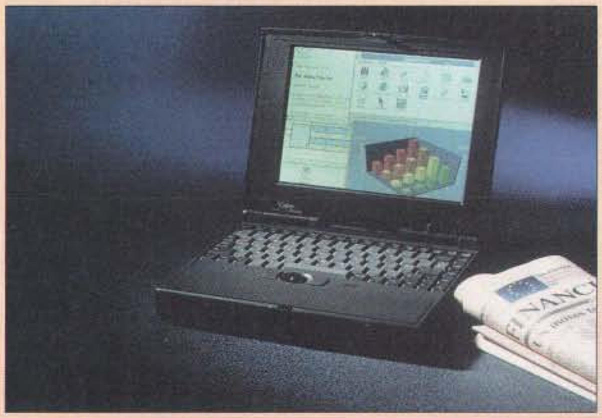

The Dossier 486 Advanced Sound notebook features built-in sound hardware that lets you record, compress, store, and play back voice, sound, and music. Available with a choice of processors—from Intel's SL-enhanced 25-MHz 486SX to the latest 75- and 100-MHz 486DX4 CPUs—the notebook comes with local-bus acceleration and 1 MB of video memory. Viglen offers memory options of up to 20 MB and hard drive options of up to 455 MB. The Dossier 486 Advanced Sound is available with three screen options: a monochrome 9.5-inch LCD (from £1149), a color 9.5-inch TFT display (from £2299), and a color 10.3-inch dual-scan STN display (from £1599). All prices are based on 486SX systems with 4 MB of RAM and a 120-MB hard drive.

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The Netprint II desktop print server can service 16 printers from a single LAN connection. You can connect five printers to Netprint II—four from bidirectional PC parallel-printer-type ports and one from the high-speed RS-232 port. Netprint II (£545) can achieve data output of 400,000 cps from the main printer port. It also supports PostScript printers in the form of conversion of ASCII to PostScript format for banner page print.

To further connect up to 12 printers, Interlink Communications (Clacton-on-Sea, U.K.) offers tiny modules, called Netpods (£95 each), that plug into the Centronics or RS-232 printer port. You can locate Netpods up to 200 meters from Netprint II and interconnect them via daisy chaining using the integral 5-meter cable supplied with each Netpod.
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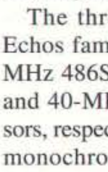
DESIGNER NOTEBOOK

Designed by Michele Di Lucchi, one of Italy's most celebrated industrial designers, Olivetti's (London, U.K.) Echos notebook comes in an ergonomic case the color of natural rubber. It features a tactile palm rest, a centrally located mouse with covered mouse buttons, and rounded corners.



The three members of the Echos family feature Intel 25-MHz 486SX, 33-MHz 486SX, and 40-MHz 486DX2 processors, respectively. The Echos 42 monochrome notebook (from £1269) comes with 4 MB of RAM and a 120-MB hard drive. The Echos 43 color notebook (from £1769) comes with 4 MB of RAM and a 170-MB hard drive. The Echos 44 color notebook (from £1969) comes with 4 MB of RAM and a 170- or 240-MB hard drive. All three come with an integrated trackball, up to 24 MB of RAM, two PCMCIA Type II slots or one Type III slot, VL-Bus video, a 9.4-inch backlit LCD, a keyboard and mouse interface, and up to 4 hours of battery life per charge.
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What's New International Hardware

COLOR DRUM SCANNER

The ScanMate Magic drum scanner uses a halogen light source. It can scan positives, negatives, prints, slides, and line art. When you use the scanner with ColorQuartet software (£12,100; without ColorQuartet, £10,350), it can produce high-quality, calibrated, CMYK prepress scans. The 250- by 314-mm drum can handle sizes from A4 and up. It spins at up to 1000 rpm, delivering a scan resolution of between 300 and 2000 dpi. Color resolution is 3 by 12 bits, giving 4096 levels per color. Output file formats include TIFF and PostScript CMYK.

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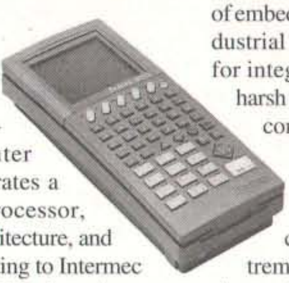

The Janus 2010BL is a hand-held data collection computer that incorporates a 386 microprocessor, IBM AT architecture, and DOS. According to Intermec (Reading, U.K.), these features allow you to develop applications using the programming tools of your choice. An internal PCMCIA card lets you carry out applications such as route accounting, asset tracking, and inventory control.

Built to withstand harsh factory environments, the Janus 2010BL (£1795) supports Intermec's laser, wand, and CCD scanner input devices. It can simplify bar code integration into standard applications through the Virtual Wedge. A large backlit LCD clearly displays operator messages. Large keys enhance ease of use and help to avoid the possibility of operator error.

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The CC4 is the latest member of Philips Industrial Automation Systems' (Eindhoven, The Netherlands) family of embedded modular PCs for industrial applications. Designed for integration in equipment in harsh environments, the CC4's compact size (14 by 9 by 16 cm) and rugged construction take into account environmental conditions such as extremes in temperature, vibration, and shock. The CC4's (call for price) four-slot design lets you configure it with a Philips EMC CPU module, which range from a 386SX to a 50-MHz 486. You can also configure it with the Philips EXM expansion modules, which include VGA and flat-panel interfaces, drives, SRAM, flash-memory modules, PCMCIA, analog and digital I/O, and network interfaces such as Ethernet, Token Ring, ARCnet, and RS-485.

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Siatel (Villeneuve la Garenne, France) designed a range of computers dedicated to process visualization. Equipped with 33-MHz 486SX or 486DX low-power- consumption processors, the STS 4000 machines can run IBM AT–compatible software, including real-time multitasking functions. Other features include 4 to 16 MB of RAM, 256 KB of cache memory, a 1-MB silicon drive or an 80- to 540-MB hard drive, an expansion slot, a parallel port, a serial port, a 10.4-inch TFT VGA screen with a resolution of 640 by 480 pixels, and a connector for an external keyboard. The STS 4000 (48,000 FF) comes with a mechanically robust chassis made of steel and aluminum. The front panel is sealed, ensuring protection against dust, dirt, and water. Options include a second serial interface (e.g., RS-232, RS-422, or RS-485).

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The TDC 3500 is Tandberg Data's (Harpenden, U.K.) first DC2000 minicartridge drive. Aimed at power users and administrators of small LANs, the TDC 3500 has a native capacity of 840 MB and a data transfer rate of 300 Kbps through a SCSI-2 connector. A wide-tape option delivers over a gigabyte of uncompressed storage. With optional hardware compression, the standard QIC minicartridge provides 1.7 GB of storage capacity with a data throughput of 600 Kbps. A 3½-inch form factor allows for easy installation in low-profile and slimline PCs. With its firmware stored in flash memory, the TDC 3500 (from £600) is plug-and-play ready.

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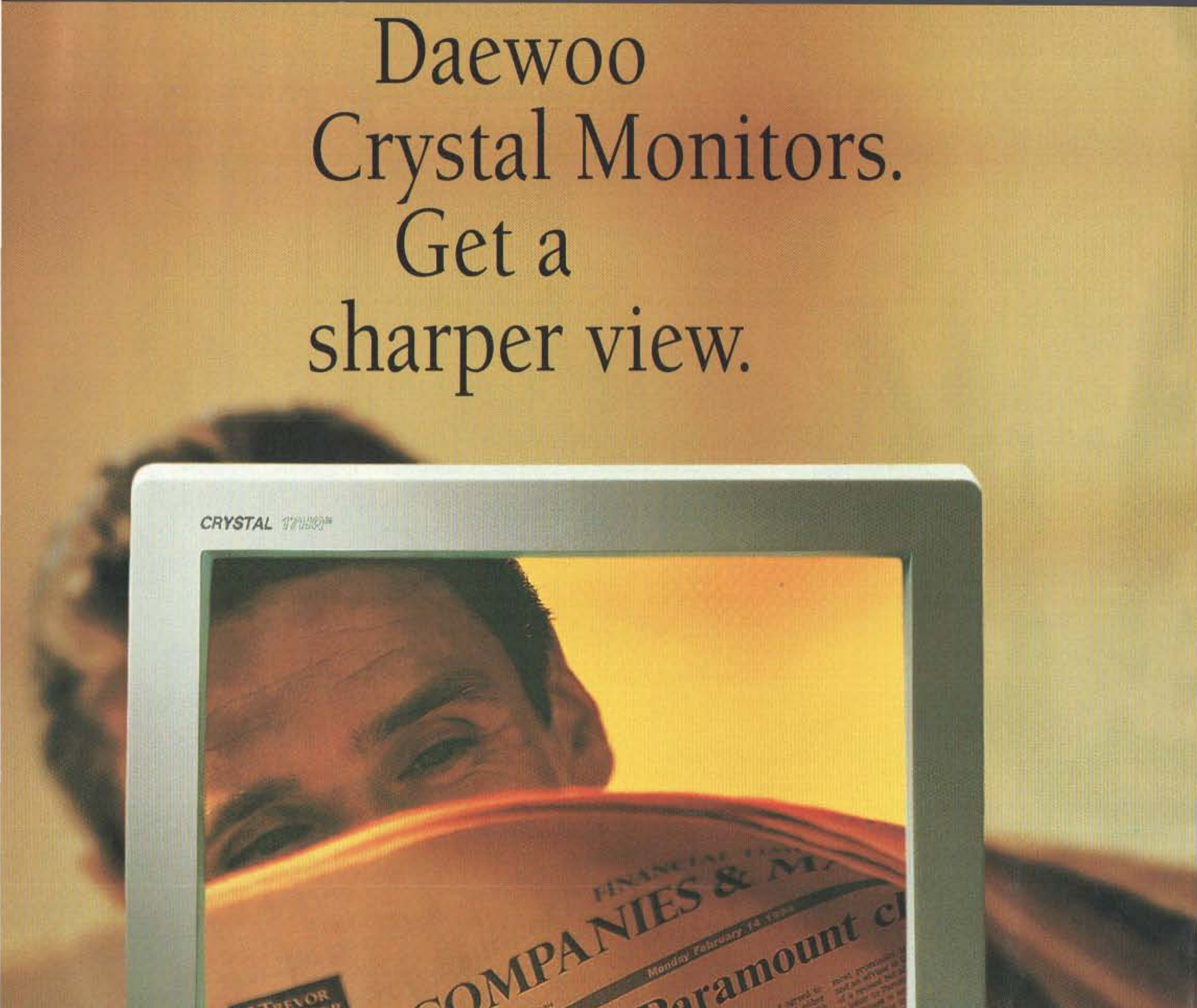

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What's New International

MULTIPLATFORM GRAPHICS TABLET

ArtPad, a low-cost pressure-sensitive tablet, is small enough to fit unobtrusively on even the most crowded desk. However, its active surface area of 191 by 175 mm is suitable for most uses (e.g., presentations, text editing, and GUI navigation). ArtPad is available for Windows, DOS, and the Mac (£159).

The graphics tablet comes with Wacom Computer Systems' (Neuss, Germany) UltraPen digitizer stylus, which doesn't require batteries or a connecting cable. Weighing only 8 grams, the UltraPen is particularly suited to creating freehand illustrations, artwork, and photo retouching. You can vary line thicknesses, intensity, and color depending on how hard you press the stylus on the tablet.

Phone: +49 2131 166001;
fax: +49 2131 101760.

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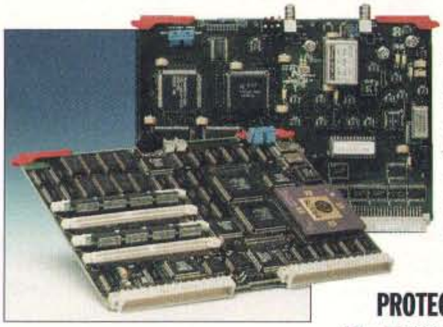

ATM VMEBUS MODULES

The Cell-Lif-VME modules (call for prices) consist of line-interface boards that offer more than one way to access ATM. Cellware Breitband Technologie (Berlin, Germany) offers modules for 155-Mbps electrical and optical devices, 100-Mbps optical devices conforming to the ATM UNI specifications, and E3 electrical devices to serve PDH links.

The Cell-AAL-VME modules (call for prices) serve AAL3/4,5 services for data communication and AAL1 services for constant-bit-rate services like voice, video, and multimedia. You can use the boards to upgrade existing hubs, routers, or switches to provide ATM functionality in the early stages of development.

Phone: +49 3046 70820;
fax: +49 3046 307658.

Circle 1431 on Inquiry Card.

20-INCH COLOR MONITOR

Hitachi New Media offers the CM2098, a 20-inch, digitally controlled, multiscanning color monitor. Incorporating the company's software control system and a high refresh capability, the CM2098 is suitable for GUI-based applications, where a larger screen can be advantageous (e.g., multimedia, 3-D modeling, desktop publishing, and entry-level CAD).

The CM2098 can automatically adjust to resolutions of up to 1280 by 1024 dpi at 80 Hz, with an option of 1600 by 1200 dpi. The monitor offers a horizontal frequency range of up to 90 Hz, a vertical refresh rate of up to 150 Hz, and a dot pitch of 0.31 mm. Thirty-one preset monitor values ensure ease of operation, or you can adopt your own values using the optional software control system to control the CM2098's (£1395) display size, position, pin cushion, trapezoid, rotation, brightness, and contrast. In addition, an RGB system lets you regulate the display colors, making them as close to natural as possible.

Contact: Hitachi New Media Ltd., Hayes, U.K., +44 81 849 2092; fax: +44 81 569 2763.

Circle 1423 on Inquiry Card.

PROTECT YOUR SOFTWARE

The UniKey System dramatically cuts the cost of using hardware-based systems to protect software from piracy, according to Software Security International (Egham, U.K.). With it, you need only one device to protect the software through its entire life cycle. When you issue updates, new releases, or even add-on products, you can reconfigure the UniKey System up to 10 times to incorporate them into the protection system. The UniKey System (call for price) lets you do this by telephone or fax.

Phone: +44 784 430060;
fax: +44 784 430050.

Circle 1442 on Inquiry Card.

PENTIUM MINITOWER SERVERS

A new generation of leading-edge Pentium minitower servers is available from Acer (High Wycombe, U.K.). The AcerAltos 900 offers entry-level system specifications with extra power, provides 90-MHz Pentium processing performance, and has PCI local bus and 8 GB of storage capacity. It supports three PCI slots, as well as the five standard ISA slots. The high-speed PCI Fast SCSI-2 interface benefits from 128 KB of FIFO buffer memory between the PCI and SCSI buses to maximize I/O data throughput and maintain disk activity. The AcerAltos 900 comes with 8 MB of RAM (expandable to 128 MB), a 540-MB hard drive, DOS 6.2, and Windows for Workgroups (£2450).

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fax: +44 628 542071.

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Controllers

Adaptec 2742WK Wide EISA Kit	389
Adaptec 1542CF/Plus	199/315
Adaptec 2742A EISA SCSI	327
Adaptec 2842C VLB SCSI	296
Buslogic ST445 SCSI VLB	280
DPT Sm Cache EISA SCSI	452
Orchid Super IDE/VLB	58
QLogic FastSCSI PCI	305
UltraStor IDE Cache 1MB	234

Graphics Cards

ATI Gr Ultra Pro TURBO 4MB VLB	580
DiamStealth 32 2MB VLB/PCI	180
Diam Stealth 64 4MB VLB/PCI	472
Diam Viper 2MB VLB/PCI	314/330
Matrox MGA 2+ 64-bit VLB/PCI	493
Mitac S3 PS805	80
Mitac W32P	112
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Lan Performance 100Mbs TP	188
Intel EtherExpress16/Combo	100/116
Intel EtherExpress FlashC	127
Intel EtherExpress 32 EISA	383
NE 2000 Compatible	35
NE 2000 Plus	100
NE 2000 Plus 5 Pack	450
NE 3210 EISA	195
SMC Elite-16 Ultra	100
SMC Elite-16 Ultra Combo	118
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Thos C 16/4TR	289

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Windows NT Adv Srvr	958
Windows for WG Starter Kit	458

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What's New

PCMCIA REMOTE DATA ACQUISITION DEVICE

The PCM-DAS08 data acquisition product lets mobile and field scientists, engineers, and researchers perform remote data gathering more easily and with greater productivity, according to Adept Scientific Micro Systems (Letchworth, U.K.). It's a test and measurement accessory for mobile computers for current, temperature, pressure, flow, or any other process variable. The PCM-DAS08 (from £338) is I/O-mapped. As soon as you install card and socket services, it can address and control from software, such as Labtech Notebook, Vis-Sim, DACQ, and DasyLab. The ComputerBoards Universal Library provided with the PCM-DAS08 supports QuickBasic and Visual Basic for DOS, together with C and Turbo Pascal. A Windows-based DLL for Visual Basic, Visual C++, and Borland C++ is also included.

Phone: +44 462 480055;
fax: +44 462 480213.

Circle 1437 on Inquiry Card.

DIGITAL VIDEO CAMERA FOR MACS

A low-cost video camera, called Connectix QuickCam, connects to the serial port of your Mac. It offers 4-bit, gray-scale QuickTime video in image sizes of up to 240 by 320 pixels and at a rate of up to 15 fps. QuickCam (£139) lets you record QuickTime movies, capture still pictures in PICT format, and record sound. The device includes a voice-quality microphone with 6-kHz sampling (500-Hz to 3-kHz range).

Available from Computers Unlimited (London, U.K.), QuickCam includes a video-recorder application that lets you record and edit QuickTime movies you create with the camera. The package includes a desk accessory that allows you to grab digital still photos in PICT format, turning your QuickCam-equipped Mac into an instant still camera.

Phone: +44 81 200 8282;
fax: +44 81 200 3788.

Circle 1438 on Inquiry Card.

TOTAL DESKTOP COMMUNICATIONS SYSTEM

According to MultiTech Systems (Ascot, U.K.), the MultiModem PCS/MultiExpress PCS (£799) integrates all your desktop communications needs in a single product. The package consists of the MultiModem PCS with Talk Anytime hardware, MultiExpress PCS software, TalkShow document conferencing software, MultiExpress communications software, and MultiExpress Fax software.

The MultiModem PCS supports V.34/V.42bis standards for effective throughput of 115 Kbps. It is fully compatible with the ITU-T Group 3/V.17 fax standard and complies with the Class 2 standards for fax modem control.

When running MultiExpress PCS on a PC connected to a MultiModem PCS, you automatically receive data, fax, or voice calls on a single phone line. MultiExpress PCS determines the type of incoming call and launches the appropriate software via the Virtual Modem Driver. For voice calls, MultiExpress PCS turns the PC into an answering machine.

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What's New

LOW-VOLTAGE MEMORY CARDS

A range of low-voltage memory cards in 2- and 4-MB, 88-pin, DRAM configurations operate from 3.3-V power supplies. They are ideal for memory expansion in portable computers and other handheld equipment, according to Mitsubishi Electric (Hatfield, U.K.). The MelCard memory cards (call for prices) are based on 8-bit-configuration 4-Mb DRAMs. A built-in self-refresh function and the 8-bit organization reduce the number of DRAMs required to operate simultaneously for 32-bit operation from eight down to four. The company is currently developing 4- and 8-MB DRAM MelCards based on 4-bit-configuration 4-Mb DRAMs and 16-bit configuration using 16-Mb DRAMs.

Phone: +44 707 276100;
fax: +44 707 278692.

Circle 1440 on Inquiry Card.

ENERGY-EFFICIENT AND ERGONOMIC DISPLAYS

The 148X fixed-function displays reduce power consumption by 95 percent during power-down. Five out of the six 148X models (from £490) satisfy the Swedish Confederation of Professional Employees standard, using 4 to 5 W during power-down; the sixth goes to 9 W. All models exceed the U.S. EPA Energy Star requirements.

In addition, all the Memorex Telex (Wokingham, U.K.) 148X displays meet ISO9241 part 3 requirements for operator comfort and task performance via flicker-free viewing, lack of screen jitter, and luminance between foreground and background. The 1483 and 1483DSV come with PC-compatible monitors and keyboards. Converting them to a PC is cost-effective by simply replacing the logic unit with a CPU.

Phone: +44 734 441544;
fax: +44 734 441792.

Circle 1436 on Inquiry Card.

VOICE RECOGNITION

With the CIC Voice Recognition System III (from £580), your applications run in their normal way, but instead of typing in information, you speak into a microphone. The system consists of a circuit board, a microphone, and software. The microphone converts speech into electrical signals that the circuit board codes so the software can understand it.

You simply recite a passage of text into your computer, which the CIC Computers' (Southall, U.K.) system analyzes to learn to recognize your voice. Once you complete this step, your computer will be able to recognize most words, with an accuracy of 80 percent. In addition, each time that you use your computer, it learns to recognize your voice more accurately, leading eventually to an accuracy rate of 95 percent. If you use words the computer cannot identify, you simply spell them by voice or on the keyboard.

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Circle 1439 on Inquiry Card.

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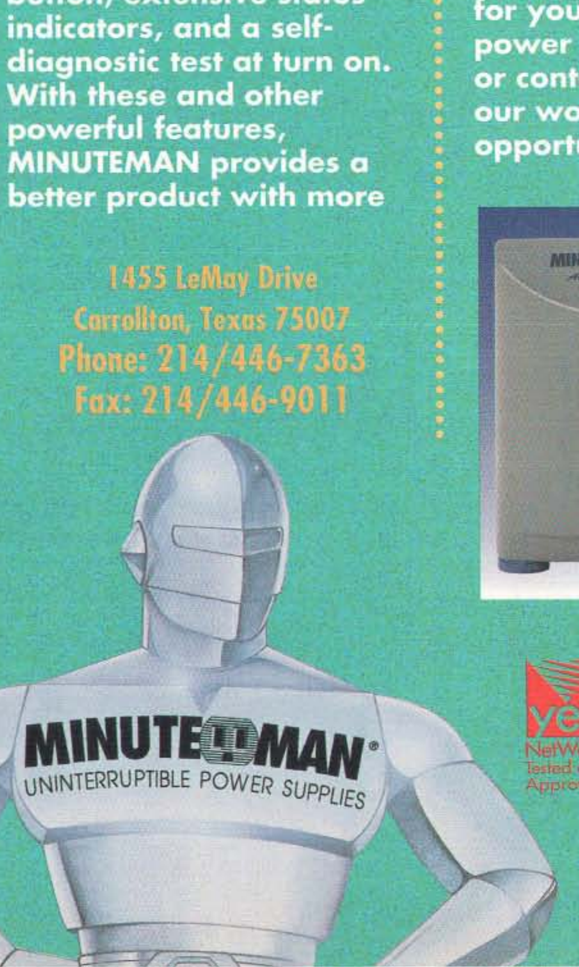

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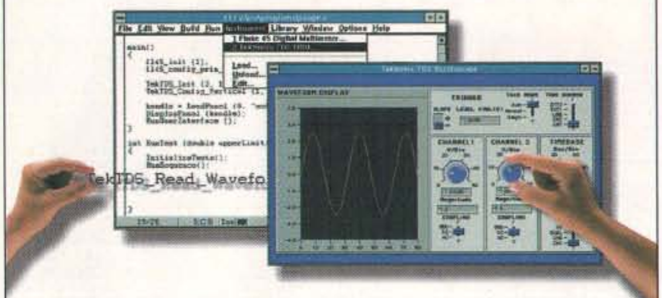

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What's New

COMMUNICATIONS BOARD

The MCIA-FID Type II communications board can handle various communications applications, including data transfer in the X.25 mode over channel D (9.6 Kbps) and channel B (64 Kbps). You can use the board in transparent mode over channel B. The MCIA-FID (call for price) conforms to the PCMCIA 2.1 standard and comes with an external adapter, which you insert between the PCMCIA board and the network for analog interfacing.

Dassault Automatismes et Telecommunications (Paris, France) has provided file transfer drivers for DOS, Windows, and Unix. An Intel 80C188 in a TQFP package handles the processing, with a clock frequency of 16 MHz and two DMA ports. The 1 MB of DRAM is fully accessible to the host computer through a 256-byte port.

Phone: +33 1 30812817;
fax: +33 1 30812224.

Circle 1441 on Inquiry Card.

LARGE-FORMAT COLOR SCANNER

Colortrac's (Huntingdon, U.K.) large-format color scanner can scan documents of any length and up to 91 cm wide at output resolutions of 100, 200, and 400 dpi. The CT36/400 operates in 24-bit true-color mode, 8- and 4-bit reduced-color modes, and 8-bit gray-scale and binary modes.

In reduced-color palette mode, on-board real-time image processing describes a document using between two and 256 colors. This form of data can represent layers of information, which is ideal for subsequent archiving, editing, analysis, or reproduction.

The CT36/400 (£27,500) comes with Windows-based software that lets you control the scanner from the host PC, plus basic image viewing and manipulation. A color-analysis module implements the on-board color classification in palette mode. Common raster file formats support simple image export to third-party software.

Phone: +44 480 434473;
fax: +44 480 434474.

Circle 1443 on Inquiry Card.

DIGITAL CAMERA BACKS FOR MACS

Phase One's StudioKit and PhotoPhase are digital camera systems for popular makes of commercial studio cameras. They're available from Computers Unlimited (London, U.K.). The camera backs let you capture high-resolution prepress-quality still images straight into a Mac, cutting costs.

StudioKit is an entry-level system that has fluorescent studio lights. Each system (Hasselblad StudioKit, £7995; Mamiya StudioKit, £8995; Large Format StudioKit, £9995) includes a scanning back, NuBus interface card, cables, and software. These systems are capable of capturing medium-resolution images of up to 25 MB.

The high-end modular PhotoPhase system consists of a range of linear-array scanning backs that fit 5- by 4-inch large-format cameras (£14,995). The range also includes camera backs to fit Hasselblad (£12,495), Mamiya (£12,495), and Fuji (£12,995) models. Capable of capturing high-resolution files of up to 103 MB, PhotoPhase produces images ready for CMYK separation in Adobe Photoshop.

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What's New International Hardware

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The Chase Research (Basingstoke, U.K.) IOPrint-Jr has a single parallel port that allows network users to share printers efficiently. Available in two versions, with either TCP/IP or IPX/SPX (Novell) support, the IOPrint-Jr has LPR/LPD support, offering print-server compatibility across multiple platforms; PServer, RPrinter, and NPrinter for Novell printing; and PConsole, Capture, and NPrint for easy installation and queue manipulation under Novell. You can connect IOPrint-Jr (£295) to thin-wire (10Base-2) Ethernet networks via the BNC-T connector or UTP Ethernet networks via the RJ-45 connector.

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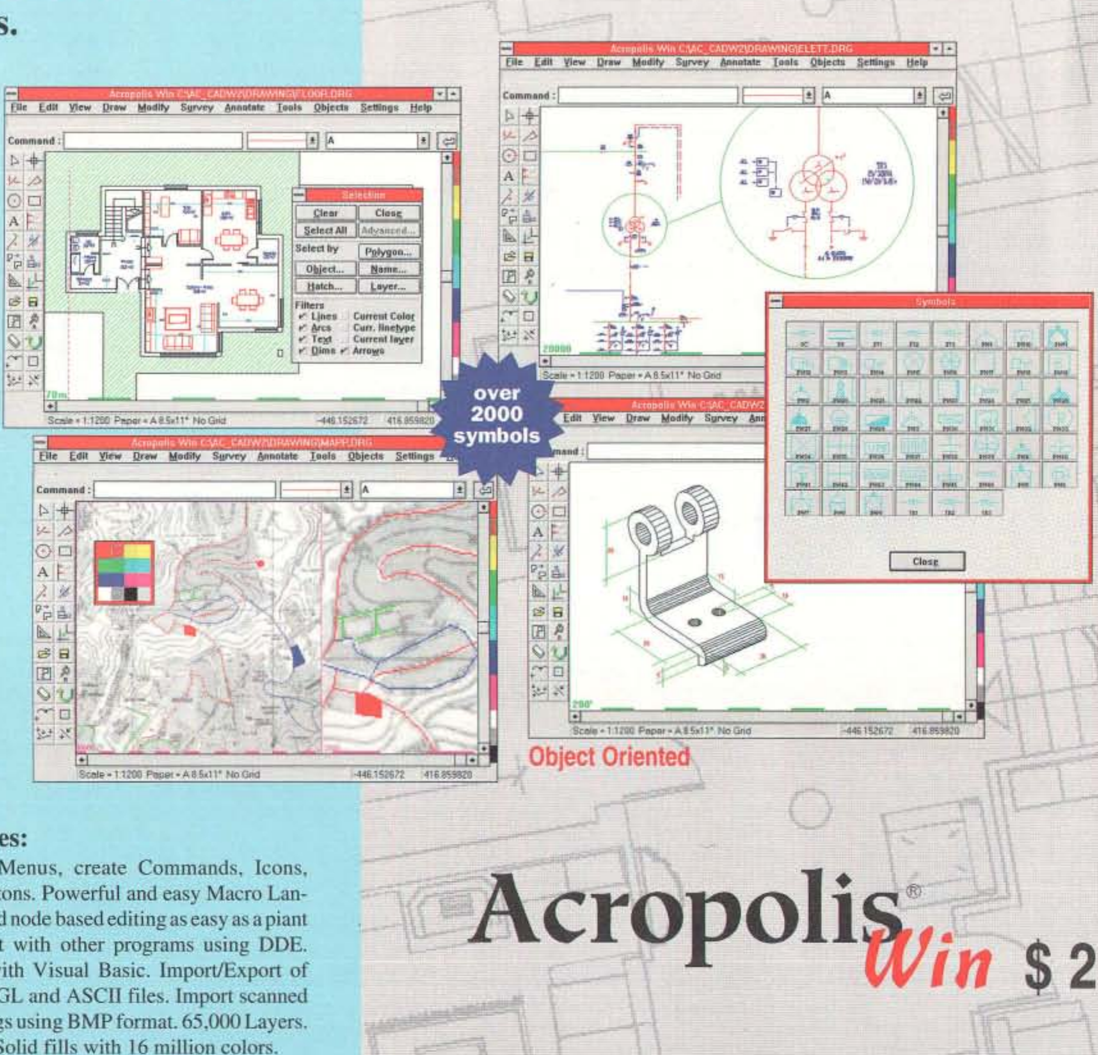
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DIRECT-IMAGING PLOTTERS

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The plotters incorporate a RISC controller with high-speed parallel links to quickly download plot files. The controller supports industry-standard CAD and various imaging formats. The plotters automatically switch between the formats, making them ideal for network use.

The G9020-S and G9030-S feature 300-dpi resolution; the G9050-S has 400-dpi resolution. The G9020-S (from £6495) comes with 4 MB of RAM (expandable to 32 MB), the G9030-S (from £8250) has 8 MB (expandable to 64 MB), and the G9050-S (from £11,995) has 8 MB (expandable to 64 MB).
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A Digital Player/Recorder transforms Fast Electronic's (London, U.K.) Video Machine into a nonlinear editing system at full Betacam SP quality. The Single Digital Player/Recorder (£3395) is a 16-bit IBM AT bus card that acts as an optional Motion-JPEG compression board. Together with the Video Machine, you can save, edit, and play live video sequences to and from the hard drive. It compresses full PAL resolution (i.e., 768 by 576 pixels) with freely selectable compression rates of 3 to 1 up to 100 to 1. You can mix tape and hard drive editing and access all the functions of the Video Machine. The Double Digital Player/Recorder (£4995) includes the same features as the Single Digital Player/Recorder plus the fully digital A/B roll nonlinear editing suite with two video channels.
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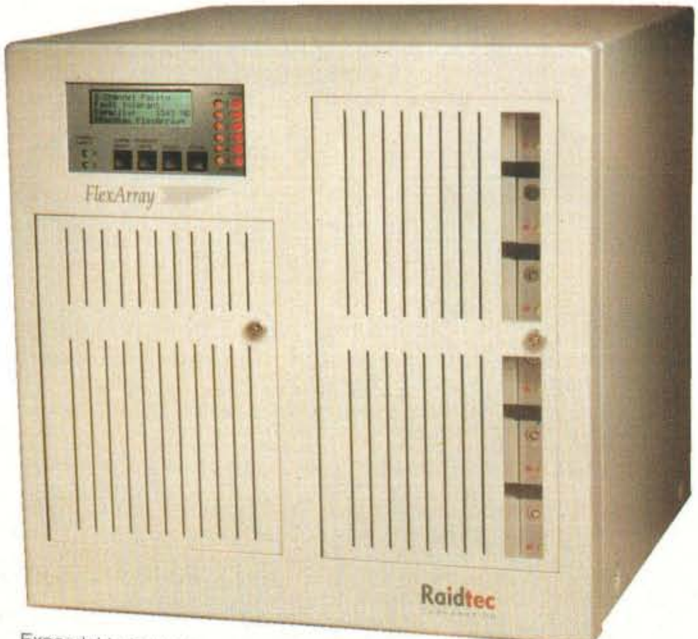

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News & Views

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VOICE-MAIL SYSTEM WITH FAX ON DEMAND

TeleOficina Plus provides features such as auto-attendant, voice mail, fax on demand with single- and dual-call methods, a modem, fax broadcasting, voice scheduling, message forwarding, a pager alert system, and an automatic program generator for voice applications.

In auto-attendant mode, TeleOficina Plus (US$500) can manage up to 3000 extensions. The system accepts tone or pulse recognition for many countries, and you can use it with or without a PBX. The automatic program generator lets you create thousands of voice/fax mail applications without coding. You can also import documents from other applications. The program from Comunycarse Network Consultants (Madrid, Spain) is available in English and Spanish versions.

Phone: +34 1 5188825;
fax: +34 1 7117863.

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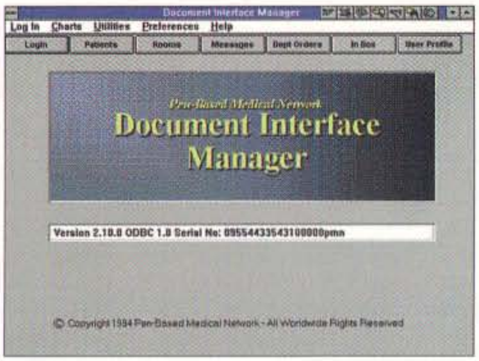
PEN-BASED MEDICAL RECORDS



Version 2.10.0 ODBC 1.0 Serial No: 0955443354310000pmn

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With Pen-Based Medical Network, clinical personnel merely write and draw on a small, battery-powered electronic clipboard tablet. They can then transmit medical notes and drawings to a computer and store them on optical disks. Doctors can access patient records from exam rooms and review appointment schedules anywhere, anytime. Pen-Based Medical Network supports Windows for Pen Computing.

Available from The York Group (Saint Germain-en-Laye, France), Pen-Based Medical Network also lets you scan photos or video images into patient notes. Doctors can call out traumatized areas on photos, create diagrams to show locations, and mark trauma locations on standardized pop-up diagrams. Pen-Based Medical Network (call for price) lets you import test data from laboratory instruments.

Phone: +33 1 39739668;
fax: +33 1 39211128.

Circle 1459 on Inquiry Card.

SLASH STATIONERY BILLS

An electronic forms management product from AFP Solutions (Woking, U.K.) eliminates the need for preprinted stationery, improves printing efficiency, and enhances the presentation, layout, and design of printed documents. The package consists of two elements: FormsManager/2 software (single-user license, £1000) and the PrInterFace IIe printer attachment (with 512 KB of memory, £450).

FormsManager/2 stores form layouts and designs, company logos and address details, signatures, and type fonts. When you send a document to print, the system automatically detects which form is required (e.g., letterhead, invoice, or fax sheet) and prints the document.

The PrInterFace IIe printer attachment lets laser printers perform at higher speeds. The device monitors the incoming data stream and matches print data with the appropriate electronically stored forms. The printer attachment can also remap print data (i.e., change its layout) without having to reprogram the original application.

Phone: +44 483 797787;
fax: +44 483 797878.

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COMPANYWIDE SECURITY

LockSmith (call for prices) provides companywide security requirements for medium to large corporate Mac sites. The package includes password access protection for up to 12 users per machine and a fully protected Private Folder for storing data. Hi Resolution (Lamberhurst, U.K.) has also optimized the screen saver for the Power Mac, so it causes no perceptible degradation in performance.

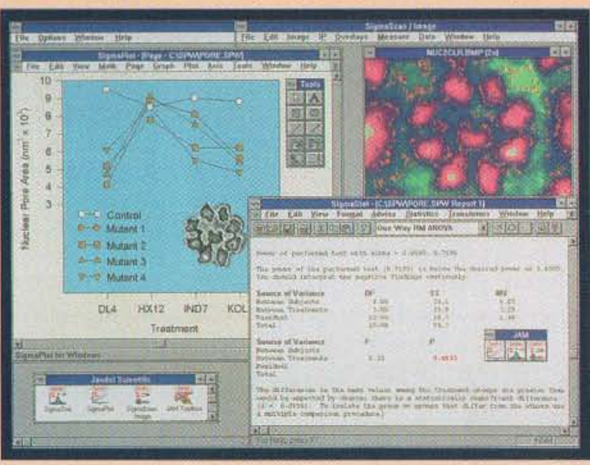
Phone and fax:
+44 892 891291.

Circle 1470 on Inquiry Card.

GRAPHICS, STATISTICS, AND IMAGE MEASUREMENT

Jandel Scientific has combined SigmaPlot, SigmaStat, and SigmaScan/Image into SigmaSuite for Windows (DM 1995), an integrated graphics, statistics, and image-measurement package. You can measure images, analyze the data, and graph the research results using a common worksheet and data-transform language. All three programs share a 16,000-column by 65,000-row worksheet, data-analysis tools, and graphics page.

SigmaPlot helps you prepare 2-D and 3-D graphs for publication with various analytical capabilities. SigmaStat advises you on the best test to use, confirms that the data fits the assumptions underlying the selected statistical method, and handles missing and unbalanced data. You can enhance your SigmaStat graphs in SigmaPlot. SigmaScan/Image provides on-screen image measurement of monochrome or color TIFF, TGA, BMP, PCX, and GIF images. You can enhance the digitized images with pseudocolor, contrast adjustment, and image splicing.



Contact: Jandel Scientific GmbH, Erkrath, Germany, +49 2104 36098; fax: +49 2104 33110.

Circle 1455 on Inquiry Card.

What's New International Software

JAPANESE WORD PROCESSOR FOR WINDOWS

According to KT Distributions (London, U.K.), KanjiWord 2.0 is the first Japanese word processor to run under Windows 3.1. Sample Japanese documents, an English spelling checker, and a 50,000-word English-Japanese dictionary help you create and edit documents in Japanese or English.

KanjiWord 2.0 (£199) includes a katana kana/kanji front-end processor to enter Japanese phonetically, a built-in Japanese Mincho font, more than 7000 JIS Level 1 and 2 Japanese characters, and multiple document editing. You can display, print, or fax to Windows-compatible monitors, printers, or fax modems; use English Windows fonts, such as TrueType, PostScript, or bit-mapped; import Japanese text files; and export KanjiWord documents.

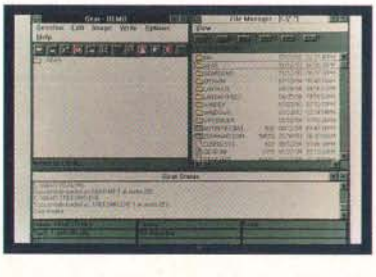
Phone: +44 71 370 6284;
fax: +44 71 370 1577.
Circle 1461 on Inquiry Card.

CD-R FORMATTING SOFTWARE

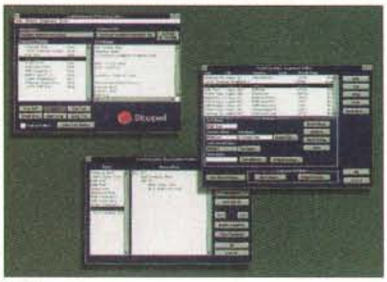
The latest version of Elektroson's (Eindhoven, The Netherlands) Gear 3.0 for Windows CD-R formatting software can create a 650-MB CD image in under 15 minutes and can handle more than 100,000 files and directory entries. Gear 3.0 for Windows (call for price) lets you have filenames of 31 characters and nest up to 12 directories.

When you drag a file or directory to the CD Image Window, Gear 3.0 automatically converts the native files to CD-ROM ISO 9660, CD-ROM XA, or DAT file format. Other features include customizable sector-level layout to optimize CD access times, advanced proprietary image-mastering options, subcode support, DDP format-mastering tape, and support for MPEG video images and CD-I files.

Phone: +31 40 515065;
fax: +31 40 514920.
Circle 1462 on Inquiry Card.



TEST EXECUTIVE TOOLKIT FOR LABWINDOWS



With the Test Executive Toolkit, LabWindows/CVI, National Instruments' (Newbury, U.K.) interactive C programming environment for instrumentation, can control the execution of test sequences for production and manufacturing test applications. The toolkit allows you to perform test sequencing based on pass/fail results, log test results, and generate ASCII test reports. The Test Executive Toolkit (£442) stores test-sequence information (e.g., test dependencies, limit specifications, and looping information) in test-sequence files, and you can create and edit these files from the application. Other features include three-level password-protected access, system setup and shutdown routines, the source code and user interface files for the entire Test Executive application, and a ready-to-run Test Executive application.

Phone: +44 635 523545;
fax: +44 635 523154.
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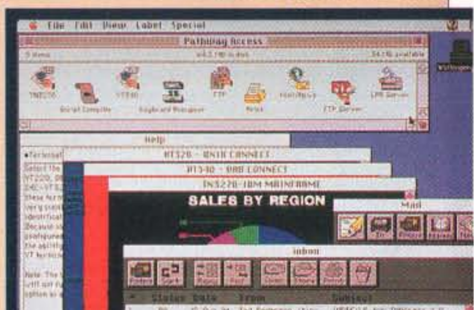
TCP/IP SUPPORT FOR QUICKDRAW GX PRINTING



The latest TCP/IP products for the Mac from Wollongong include TCP/IP support for QuickDraw GX printing. PathWay Print Redirector uses the Portable Digital Document feature of QuickDraw GX to convert documents to standard PostScript format for printing. This lets you view and print documents regardless of whether the application you create it with is present or the fonts are available.

PathWay Print Redirector (call for price) can automatically route print jobs to TCP/IP network printers using NFS or LPD protocols. Users can print simultaneously on multiple printers and switch jobs between printers, as well as drag and drop documents to desktop printing icons or print from within an application. PathWay Print Redirector is available as a standalone product or bundled with PathWay Access (call for prices).

PathWay Access 3.0 for the Mac supports IND$file for IBM host-to-Mac file transfers and IBM 3179G and VT340 Regis graphics. It includes drag-and-drop FTP, FTP scripting, keyboard remapping and macro keys, and an E-mail client and news reader. In addition, the program supports PPP.

Contact: Wollongong Ltd., Bracknell, U.K., +44 344 304242;
fax: +44 344 300080.
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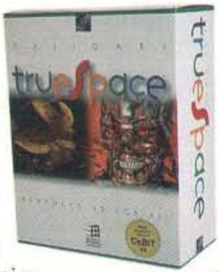
3-D MODELING, RENDERING, AND ANIMATION



Caligari TrueSpace (£595) is a 3-D modeling and rendering package for Windows that lets graphic artists, multimedia developers, video professionals, architects, and engineers work in 3-D perspective space, manipulate objects, and interact in real time. You can extrude faces in 3-D, lathe them, or sweep them across a spline path; position visible lights and cameras; and simultaneously edit multiple objects. The program lets you output to video or save in AVI/Video for Windows format. Available from The Roderick Manhattan Group (London, U.K.), Caligari TrueSpace renders in 24-bit color and provides a resolution for slides. The program supports 3-D formats such as DXF, 3D Studio, VideoScape, Wavefront, Imagine, and LightWave. It lets you import standard image formats for texture and bump mapping.

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fax: +44 81 877 1388.
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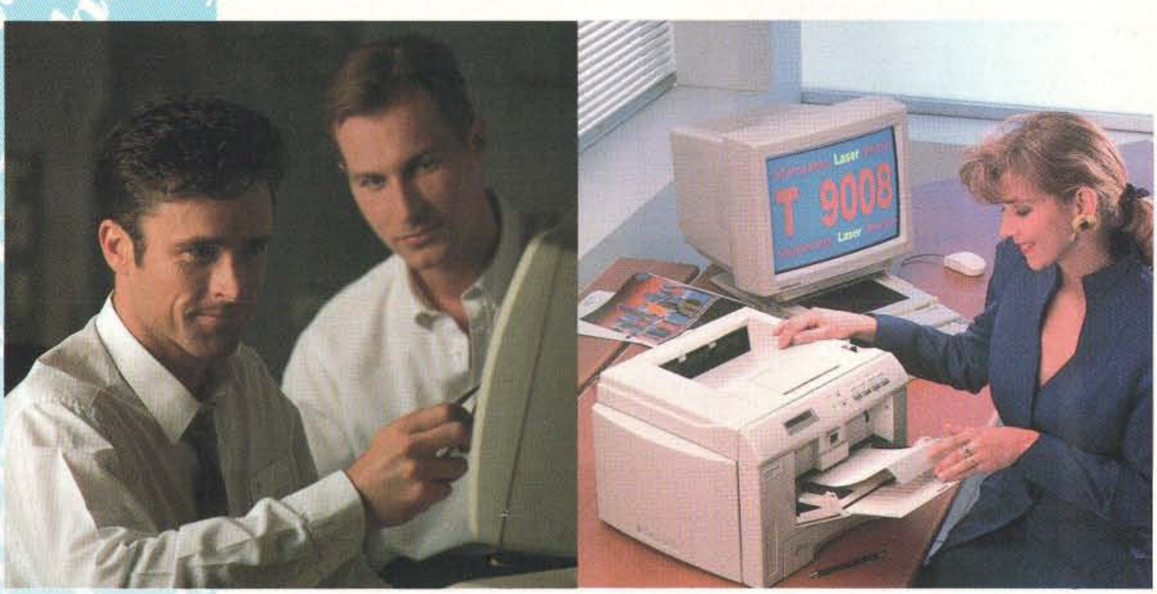

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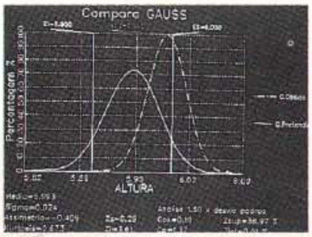

CONEQ TO QUALITY

ConEQ/DB is a powerful, simple to use, graphical and statistical program for SPC with database management, running in DOS or any PC network. Major users are certified suppliers of GM, FORD, RENAULT, PEUGEOT and others. **They are ConEQted to quality**. Don't settle for less. Free demo available at our anonymous FTP server at *asterix. intersis. pt*

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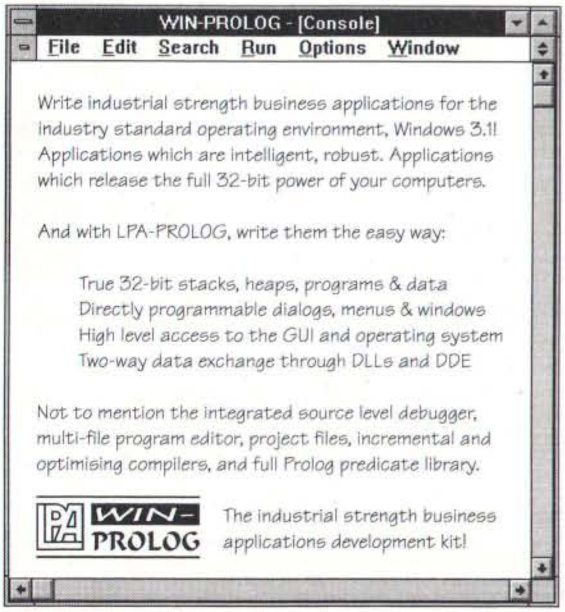

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What's New

LOCALIZED VERSIONS ▲ OF CORSTREAM

Artisoft Europe (Asnieres sur Seine, France) offers versions of the CorStream server, its 32-bit dedicated server for the LANtastic network operating system, in French, German, Italian, and Spanish. The CorStream server (call for prices) provides increased performance to LANtastic 5.0 and 6.0 networks without adding any complexity or changing the way workstation users work. Features include fault tolerance, file system/media management, mission-critical reliability, and applications compatibility.

Phone: +33 1 46880818;
fax: +33 1 40800882.

Circle 1467 on Inquiry Card.

MULTIMEDIA TOOLS

With Sentfactor Multimedia Tools, you can incorporate pictures, sound, video, and text files in one database. You choose a file, look at the image, and display it in full-screen mode or in other configurations. You can attach each set of data with pictures, create your own databases, and bring them to life with pictures, sounds, and video.

The program can read TXT files into your database, read DBF files from other databases, integrate WAV and MIDI audio into the database, capture pictures into your application, play AVI videos, scan and display images, and print individual items. Sentfactor Multimedia Tools (£99) can retrieve images from a CD-ROM; import images, sound, or video from anywhere; and export images in a number of formats.

Sentfactor (Galway, Ireland) also offers Multimedia Tools Runtime (£29.99), which lets you create an executable run-time file of your database created in Sentfactor Multimedia Tools. After you install Multimedia Tools Runtime, you select the database you want to create the run-time file of, and the program copies all the relevant files from the database into the run-time directory.

Phone: +353 91 94393;
fax: +353 91 90644.

Circle 1457 on Inquiry Card.

INTEGRATED MANAGEMENT APPLICATIONS

With Radica, you can automate processes and control work flow, monitor performance against plans, support management decisions, simulate possible scenarios, and control risk and exposure. You can use the package from Mondas Information Technology (Weybridge, U.K.) on a single PC or a multiclient, multiserver network installation with full data integrity and access controls (Application Builder license, £2495; Base User license, £995; Simulation license, £1195; Risk Management license, £2495).

The program holds the structures, policies, procedures, objectives, expectations, time scales, and other elements that govern a business and processes transactions across a number of systems.

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Compex Ethernet.

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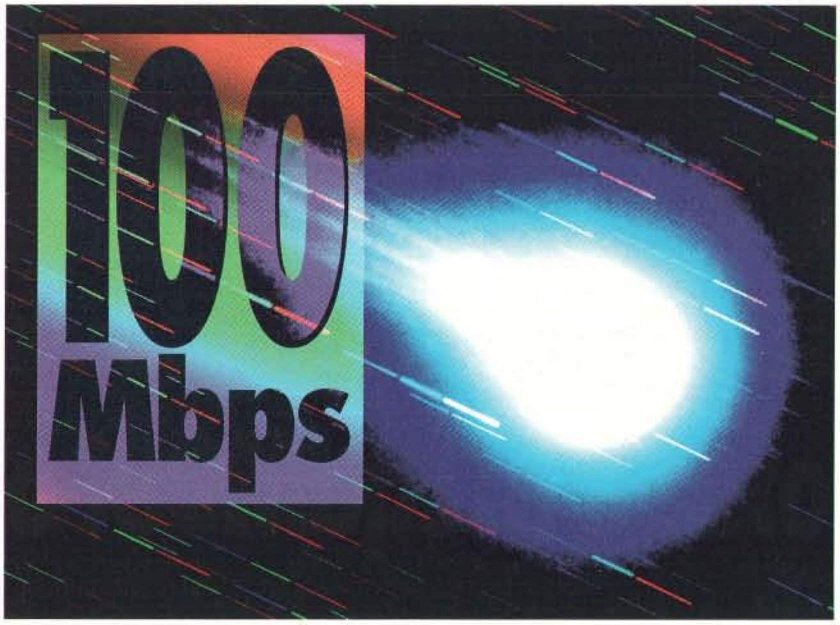

New ReadyLINK ENET100-VG4 Series.

Here's the fastest way to get a white hot 10X boost in network throughput without ripping out your existing UTP wiring. With new ReadyLINK ENET100-VG4 series adapters you can switch from 10Mbps to 100Mbps transmission in 3 seconds or less to efficiently handle multimedia, video conferencing, shared user and other bandwidth-intensive applications. And there's more:

- Card includes two RJ45 connectors (one each for 10Mbps and 100Mbps operations) and one BNC connector (for 10Mbps operations).
- When your network is equipped with a 100VG-AnyLAN compatible hub, you can quickly change from 10Mbps to 100Mbps transmission by simply unplugging from one RJ45 and connecting the cable to the other.
- The ReadyLINK VG1400/6 hub features 6 RJ-45 (100Mbps) ports with one uplink port for easy cascading. It is ideal for small workgroups requiring high bandwidth. Small, slim footprint design, extensive status LEDs, auto parity detection and correction for inverted cable.
- Software automatically senses change in transmission rate.
- 100VG-AnyLAN technology.
- Supports IEEE 802.12 standard.
- Driver support for all popular network operating systems.
- Uses standard 4-pair Category 3, 4 or 5 UTP cabling.
- ISA and EISA versions available.

If you are looking for the fastest way to get from 10Mbps to 100Mbps, ask for ReadyLINK.

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Real-Time Multitasking

for Microsoft C, Borland C, Borland Pascal

Develop Real-Time Multitasking Applications with *RTKernel!*

RTKernel is a professional, high-performance real-time multitasking kernel. It runs under MS-DOS or in ROM and supports Microsoft C, Borland C++, Borland/Turbo Pascal, and Stony Brook Pascal⁺. RTKernel is a library you can link to your application. It lets you run several functions/procedures as parallel tasks and offers the following advanced features:

- pre-emptive, event/interrupt-driven scheduling
- number of tasks only limited by RAM
- task-switch time of 6 µ s (33-MHz 486)
- up to 64 priorities (changeable at run-time)
- time-slicing can be activated
- timer interrupt rate of 0.1 to 55 ms
- high-resolution interval timer (1 µ s)
- activate or suspend tasks out of interrupt handlers
- programmable interrupt priorities
- inter-task communications using semaphores, mailboxes, and message-passing
- keyboard, hard disk, floppy disk idle times usable by other tasks
- supports math coprocessor and emulator
- supports up to 36 COM ports (DigiBoard and Hostess boards)
- protocols XOn/XOff, DTR/DSR, RTS/CTS
- full support of NS16550 UART chip
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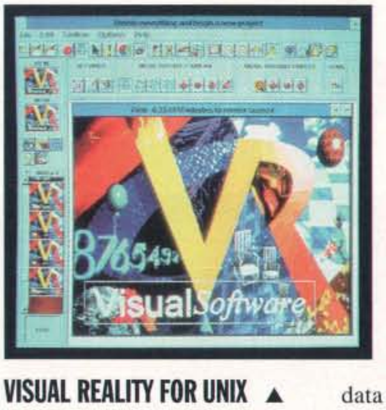
SCOPE COMMUNICATIONS

What's New



VISUAL REALITY FOR UNIX ▲

Visual Reality for Unix, VisualSoftware Exports' (St. Peter Port, U.K.) 3-D graphics and animation product suite for CAD designers and graphic artists, provides the tools you need to create realistic 3-D models and images, entry-level animations, and scenes. Visual Reality (£495) includes three programs that work together and two CDs of clip art and textures.

RenderizeLive 3.2, a 3-D rendering and animation tool, lets you combine input from other Visual Reality modules and images to create full-color, high-resolution, photo-realistic renderings. You can animate these renderings as if a camera is moving through the scene.

A full Boolean solids modeler, Visual Model offers sophisticated capabilities for building simple 3-D objects and editing 3-D clip art. Visual Player plays animations in FLI and FLC formats or frame by frame.

Visual 3-D ClipArt libraries are professionally drawn and ready for rendering, so you can create scenes with no modeling. Image-CELS Textures and Materials provides seamless texture maps for building materials, industrial finishes, and environmental images, including bricks, marbles, metals, stones, designer textures, backgrounds, and background images.

Phone: +44 481 714572;
fax: +44 481 714573.

Circle 1466 on Inquiry Card.

SECURE DATA TRANSFER BETWEEN PCS ▼

PC Security (Marlow, U.K.) has added the following to Stoplock V 2: secure data transfer, Temporary and Guest options for user profiles, a Secure Client Interface facility, and a series of enhanced utilities. Data you write to an Import directory remains encrypted until read, while data you write to an Export directory stays encrypted and cannot be decrypted when read. Your data remains encrypted during the transfer process, and only PCs with the same Master Encryption Key can share it.

The Secure Client Interface facility lets the software share security information with other security systems. When this facility is active, Stoplock V can operate in master or slave mode. The Trusted Process function lets programs such as backup and virus protection run in a secured environment. Stoplock V 2 (from £195) also includes boot protection, screen blanking, an audit trail, device control, directory and file control, data encryption, and virus protection.

Phone: +44 1628 890390;
fax: +44 1628 890116.

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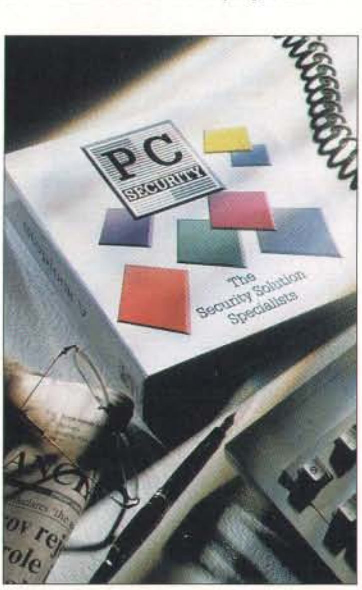

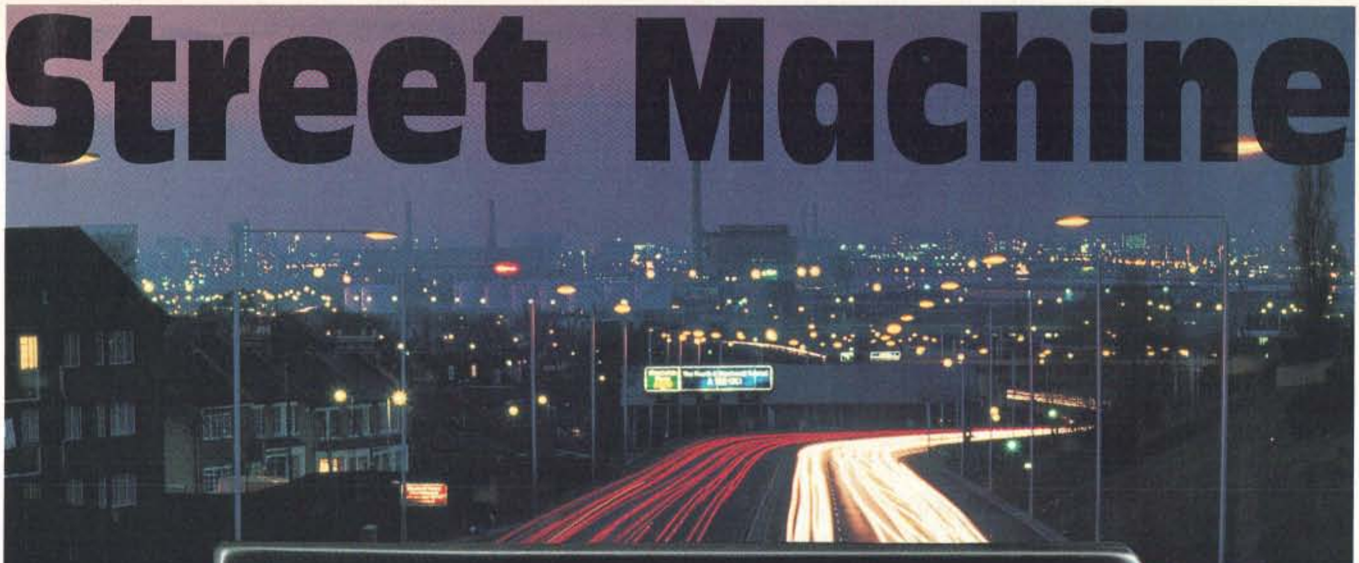

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What's New

WINDOWS-BASED REPORT WRITING

Data Access (Watford, U.K.) offers WinQL 2.0 Standard Edition and WinQL 2.0b SQL Edition. A Windows-based report writer, WinQL consists of a WYSIWYG report designer and a print-engine server for hard-copy reproduction. You can customize reports for clear presentation and analysis of information.

WinQL 2.0 Standard Edition (from £250) lets you create executable reports, which you can print by clicking on an icon; format multiple fields at the same time; compress files in the record selection box; and browse fields on the report or in a record selection. Version 2.0 can also access and analyze information contained in DataFlex, Paradox, Btrieve, Xbase, DIF, SYLK, and ASCII file formats.

WinQL 2.0b SQL Edition (from £395) provides access to information from SQL engines such as Oracle SQL, NetWare SQL, Gupta SQLbase, Microsoft and Sybase SQL Server, and products that can communicate via ODBC. Version 2.0 can also access file formats that WinQL 2.0 Standard Edition supports. You can link SQL tables to your DataFlex, Xbase, Paradox, or Btrieve files for reporting on enterprise-wide and departmental information.

Phone: +44 923 242222;
fax: +44 923 249269.

Circle 1477 on Inquiry Card.

BRIDGE THE IMAGE FILE INCOMPATIBILITY GAP

When you are faced with incompatible image files, disk space limitations, color conversion, and image sizing, Image Alchemy can solve these problems by translating between file formats and their variations. The product supports more than 50 file formats. Where a file format is not listed, PDI Systems (Camberley, U.K.) says it can produce the necessary conversion.

The program supports PICT, EPS, TIFF, Targa, PCX, JPEG, BMP, WPG, and PGM file formats, as well as Autologic, Calcomp, PictureMaker, Sun Icon and Raster, Utah RLE, OS/2 BitMap and Icon, FoP, and Cals. Image Alchemy (call for price) is available for IBM PCs and a number of other environments.

Phone: +44 276 691198;
fax: +44 276 691913.

Circle 1468 on Inquiry Card.

PRETTY PRINTER FOR VISUAL BASIC

Aardvark Software's Pretty Printer 2.0 for Visual Basic prints formatted program listings that help programmers quickly identify programming errors and understand and maintain software code. Version 2.0 features Connection Lines, which graphically connect the beginning and end of each calling structure.

Available from Grey Matter (Asburton, U.K.), Pretty Printer 2.0 for Visual Basic (£79) lets you choose which modules, subs, and functions you want to print; automatically formats the source code as it prints; prints procedures separated by a graphical dividing line or each starting on a new page; and detects when a comment related to a procedure precedes the actual code definition and prints the comment with the following procedure. The program also features customized page headers; formatting options for font, style, size, and background; and color printing.

Phone: +44 364 654100;
fax: +44 364 654200.

Circle 1471 on Inquiry Card.

What's New International Software

OXFORD REFERENCE SHELF ON CD-ROM

Oxford University Press (Oxford, U.K.) has combined 16 books into the Oxford Reference Shelf CD-ROM (£79.99). The CD-ROM includes the *Pocket Oxford Dictionary*, *Oxford Dictionary for Writers and Editors*, *Oxford Guide to English Usage*, *Oxford Minidictionary of Quotations*, a compact encyclopedia, a concise dictionary of business, a concise dictionary of law, *Oxford Dictionary of Abbreviations*, a world gazetteer, a concise science dictionary, the *Oxford Dictionary for Scientific Writers and Editors*, a dictionary of computing, and some language dictionaries. The software features instant cross-referencing, wild-card searching, a conversion utility for measurements and roman numerals, a periodic table, a history button, and a watch-clipboard button.

The company also offers the Oxford Compendium on CD-ROM (£79.99), a compilation of Oxford dictionaries. You get 190,000 words defined, 275,000 synonyms, and more than 20,000 quotations. The software features Boolean operators, wild-card searching, instant cross-referencing, a history button, and a DDE link with Word for Windows.

Phone: +44 865 56767;
fax: +44 865 56646.

Circle 1474 on Inquiry Card.

MULTILINGUAL SMARTERM FOR WINDOWS

The multilingual version of SmarTerm for Windows (call for price) PC-to-host connectivity software is designed to meet the needs of multinational corporations looking to standardize on a single connectivity solution. Available in English, French, German, and Spanish, SmarTerm 420 for Windows 4.0 and SmarTerm 340 for Windows 4.0 include fully translated main program menus and dialog boxes, help systems, and a user installation and overview guide. Version 4.0 offers SCO Console support, Microsoft Office compatibility, an FTP File Viewer utility, and ISO Latin-2 character set support.

Persoft's (Henley-on-Thames, U.K.) SmarTerm 420 for Windows 4.0 provides PC access to Unix and VMS hosts through emulation of Digital VT420 text terminals. SmarTerm 340 for Windows 4.0 emulates Digital VT340 graphics terminals and Digital VT420 text terminals and offers Regis, Tektronix, and pixel graphics support.

Phone: +44 491 638090;
fax: +44 491 638010.

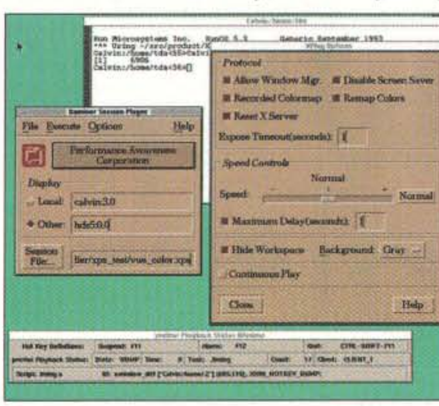
Circle 1473 on Inquiry Card.

COMPUTER-AIDED SOFTWARE TESTING

Release 4.0 of Performance Awareness's PreVue-X offers productivity improvements for regression testing, stress testing, and benchmarking of ASCII and X Window System–based applications. Based on remote terminal-emulation technology, the software runs on stand-alone or networked Unix systems.

Available from Magic Computer Services (St. Albans, U.K.), PreVue-X automates the testing process and provides a common methodology and feature set for software and system testing. The program records user sessions and plays them back as single-user or multiuser workloads. Postanalysis utilities compare expected versus actual system responses and calculate response times for each user action.

Release 4.0 (from £7625) lets you use a single display for recording and playback. Other features include X11R6-based X pseudoserver capabilities and a transaction utility, which lets you export filtered response time data for incorporating into databases and spreadsheets.



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yes It runs with NetWare

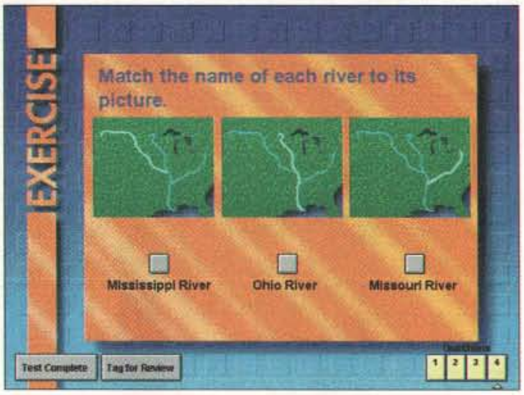
LANSource

Circle 529 on Inquiry Card.

What's New International Software

SIMPLE WINDOWS MULTIMEDIA DEVELOPMENT

A computer-based training-course development system, AimTech's (London, U.K.) CBT Express for Windows comes with templates and 375 color backgrounds that simplify and accelerate interactive multimedia training development. The templates have student login/registration, objectives, menus, lessons, summaries, course maps, and glossaries. Testing exercises such as true/false, matching, multiple-choice, and fill-in-the-blanks comply to standard design principles for CBT development. Student tracking tabulates the critical data related to the progress of trainees through an entire course.



Match the name of each river to its picture.

Shipping on a CD-ROM, CBT Express for Windows (£2395) includes a library of sample audio, video, and animation clips. The program incorporates pen-and-paper and electronic storyboarding techniques that help you match animation, video, and graphics files with course mapping and design. A storyboard planning workbook, user manual, and CBT course on learning and using CBT Express for Windows are also included.

Phone: +44 71 702 1575;
fax: +44 71 702 1576.

Circle 1022 on Inquiry Card.

FORCHECK FOR WINDOWS

Forcheck, a FORTRAN program development aid from Leiden University (Leiden, The Netherlands), verifies the syntax of individual program units and the program as a whole. You can compare the syntax for strict conformance to the FORTRAN 77 or 90 standard. Forcheck verifies the entire program by checking the consistency of subprogram types, argument lists, common blocks, and include files.

Forcheck for Windows (Dfl 1050) is more than a Windows implementation of the static analyzer. It is a programmer's workbench from which you can develop, verify, and maintain FORTRAN programs. You can analyze selected source files or perform a complete analysis on a project; select options; edit source files; generate, view, and print listings and reports; view and maintain library files; and compile and rebuild the executable files.

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This unique Center fom Integrix gives you the choice of a powerful **SPARCstation™ 10 or 20 system board** to ensure that your critical business applications flow continuously. Full software compatibility gives you a rich variety of options and ease of network interaction. You can put our wide range of add-ons and upgrades to work for you today.

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Integrix leads the market with **award-winning expansion solutions.** The SEC160 Expansion Chassis adds six SBus slots to any SPARCstation enhancing system value and functionality.

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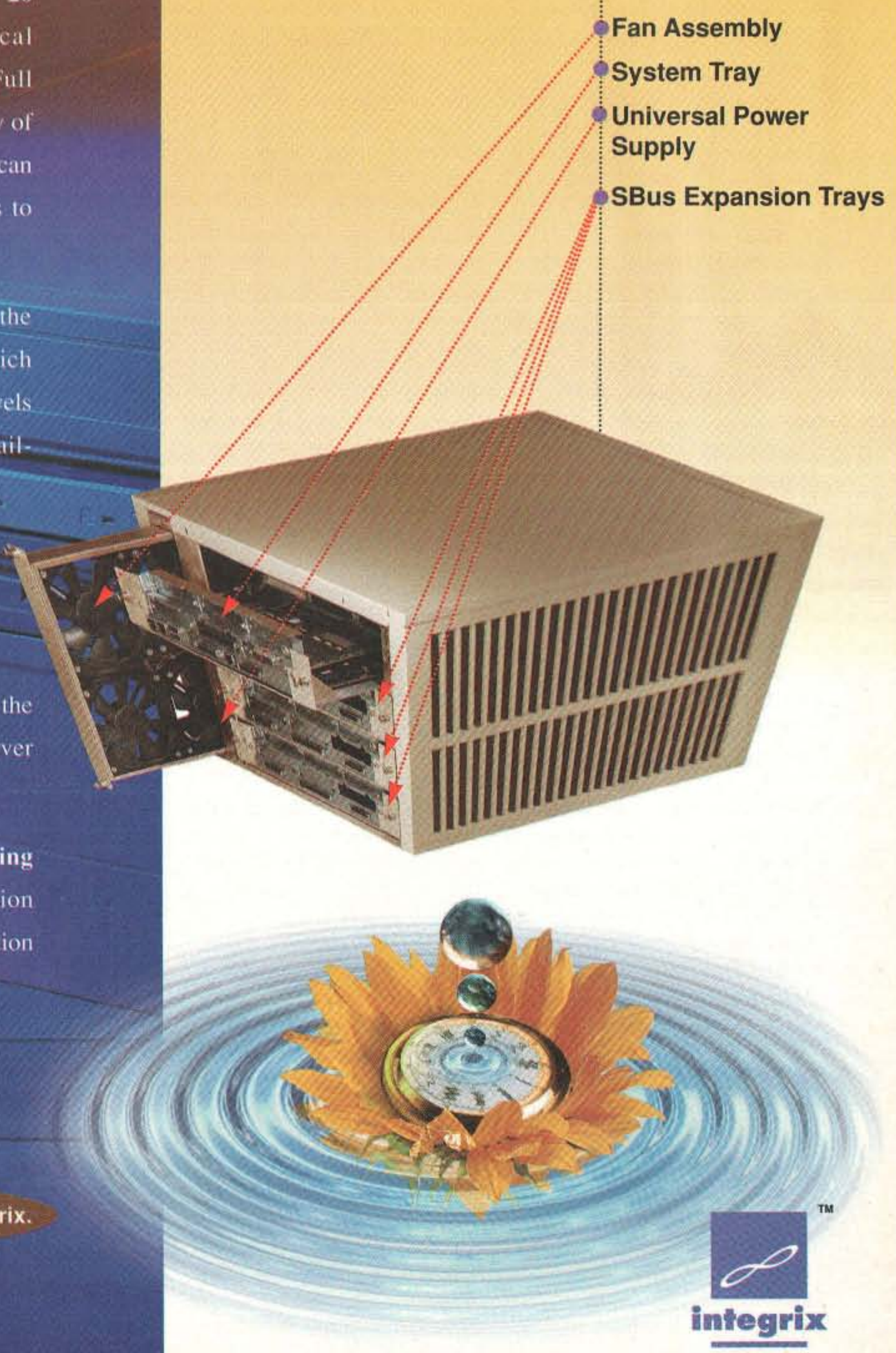

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Circle 551 on Inquiry Card.

What's New International

MANAGEMENT TOOL FOR CAD

LT Manager for Windows groups AutoCAD LT and AutoCAD 12 for Windows drawings into customizable drawing registers, so you can search on any drawing information without having to remember cryptic DOS filenames. The program also records modification and version information. It can make issued versions of designs read-only to prevent unauthorized editing.

The program from EDM Consultants (Great Barford, U.K.) allows you to group drawings by projects, disciplines, and work flow, each with its data in the form of a record card. LT Manager for Windows (£199) lets you define critical points within the work-flow cycle, maintain modification notes related to the drawing, create revisions without reentering drawing data, and retain multiple revisions of the same drawing.

Phone: +44 234 870088;
fax: +44 234 871235.

Circle 1472 on Inquiry Card.

E-MAIL AND FAX INTEGRATION

Faxination makes full desktop E-mail and fax integration a realistic option, according to C2C Systems (Caversham, U.K.). The package for Microsoft and Lotus E-mail users supports multiple lines from one location. E-mail features funnel information from all offices to a central point for handling. The fax technology can send information over 16 lines from one location.

The Faxination Gateway lets E-mail users freely incorporate headers or logos, take advantage of off-peak call rates, and batch faxes to a single location.

Three versions of Faxination are available (single-user version, from £2795; multiline version, from £4995): the Standard version, which features a single line with cover-sheet options and inbound routing and management features; the Corporate version has up to four lines, with inbound routing and management features, advanced cost management, and print-queue support; and the Enterprise version, with up to 16-line support and least-cost routing.

Phone: +44 734 464411;
fax: +44 734 462885.

Circle 1478 on Inquiry Card.

LIFE-STYLE PRODUCTS

SoftKey International (Wimbledon Common, U.K.) offers a lifestyle product range. MasterCook II (£29.99) offers 1000 recipes. It can take your ingredients, tell you what you can cook with them, and give you a nutritional analysis of each dish. WineSelect (£29.99) helps you select wines to complement food combinations and includes a 17-lesson course in wine appreciation. With more than 10,000 recipes, Key Home Gourmet (£34.95) helps you prepare food for any occasion. You can print your shopping list and recipes, and the program includes 100 cocktail recipes and nutritional analyses for each recipe.

For designing landscape and vegetable gardens, Key Garden Planner (£34.95) includes hundreds of tree, shrub, fencing, plant, and garden clip-art images, as well as an aging feature that lets you see what your garden will look like as it grows over the years. Key Home Designer (£34.95) helps you plan and design a house with four step-by-step modules. With the Key HomeCAD feature, you can lay out and design accurate blueprint plans.

Phone: +44 81 789 2000;
fax: +44 81 789 5626.

Circle 1476 on Inquiry Card.

POWER MAC VERSIONS OF CUMULUS AND CIRRUS

Computers Unlimited (London, U.K.) provides native Power Mac versions of Canto Software's Cumulus and Cirrus (call for prices). Cumulus is a fast image and multimedia database for indexing and archiving images, documents, and multimedia formats on the Mac. Cirrus is a state-of-the-art scan and image-manipulation program.

Cumulus PowerLite 2.0 is a single-user version that offers improvements such as hierarchical keywords, drag and drop, and multilevel Boolean searches. Cumulus PowerPro 2.0 is a professional client/server network solution that offers all the features of PowerLite plus AppleScript support. Supplementing this upgrade, Cumulus PowerReader is a browsing tool for content providers who wish to distribute Cumulus PowerPro catalogs on removable media.

Providing support for more than 100 scanner models, Canto Software brings power-scanning efficiency to the Power Mac with Cirrus. Cirrus PowerLite 2.1 is a consumer version for entry-level to midrange scanning. Cirrus PowerPro 2.1 includes AppleScript automation and ColorSync system-level calibration.

Phone: +44 81 200 8282;
fax: +44 81 200 3788.

Circle 1480 on Inquiry Card.

CHARTING TOOL FOR VISUAL BASIC

VBGraphix (£325), a Visual Basic graphics tool from MicroHelp, provides more than 12 drawing capabilities, such as arc, ellipse, circle, square, pencil, frame, text, and line. Ten charting types let you create 2-D and 3-D presentations. You can integrate pictures into charts and put many charts on a page. Other features of VBGraphix, which is available from Contemporary Software (St. Albans, U.K.), include unlimited palettes, zooming, zero as null, support for a comprehensive clip-art library, and facilities to adjust thickness and colors and rotate objects by degrees and handles.

Phone: +44 727 811999;
fax: +44 727 848991.

Circle 1023 on Inquiry Card.

Btrieve Technologies, Inc.
Authorized Channel Partne

AUSTRALIA
Fagan
6-13-699-9899

BENELUX
Artefact
31-15-617532

CZECH REPUBLIC
SWS
42-67-981446

FRANCE
Interquad
33-1-41-101500

GERMANY
Compu-Shack
49-2631-983381

HONG KONG
Jardine
852-565-2011

HUNGARY
Walton Networking
36-1-267-9010

INDIA
S.M.I.L.E.
91-22-8364724

ITALY
A&B
39-10-2770530

JAPAN
Novell Japan
81-3-5481-1161
AG-Tech
81-52-951-7054

KOREA
Suntek
82-2-715-4796

MALAYSIA
Autocomp
6-03-2442002

RUSSIA
ELCO
7-095-131-5555
Unitech
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SWEDEN
Linsoft
46-13-111588

UNITED KINGDOM
System Science
44-71-833-1022

OTHER COUNTRIES
Contact Btrieve Technologies
512-794-1719
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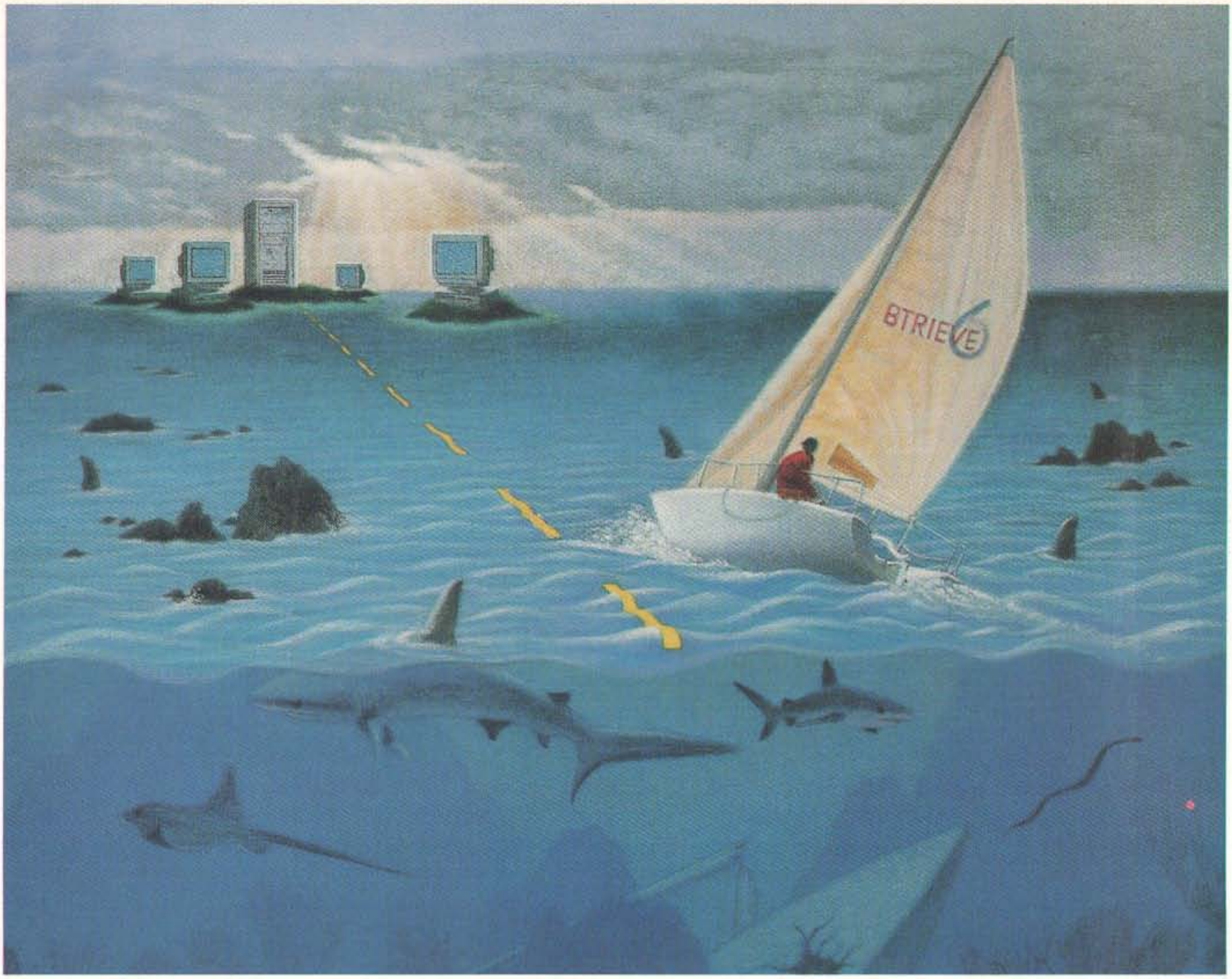


THERE IS A SAFE, DIRECT ROUTE TO CLIENT/SERVER.

NAVIGATE YOUR WAY WITH BTRIEVE 6.

Now you can move to client/server without giving up the control professional programmers demand. The secret is Btrieve 6 Database Manager, and it makes the change to client/server far less uncertain.

INTRODUCING NAVIGATIONAL CLIENT/SERVER

Predetermined SQL optimization routines can limit your control and performance. With navigational client/server, you can chart the fastest path to your data by designing relational structures and following them with precise directional controls to retrieve, insert, delete and update distributed data.

As the first navigational client/server database, Btrieve 6 provides the infrastructure to build multigigabyte database servers that can support hundreds of users with subsecond response times. Using your existing 3, 4 and 5GL tools, create or replace your data management code with Btrieve 6. Couple it with the application code and you're there. Btrieve 6 supports the major server platforms, NetWare Windows NT, and OS/2 and the major client platforms.

Btrieve 6 directional controls integrate with existing application code so you can easily upgrade non-SQL applications to client/server. This way, your end-users won't need the kind of massive retraining that accompanies a change to SQL applications, an effort that can take from 40 to 50% of the typical conversion budget. (Source: The Gartner Group)

THE PAINLESS WAY TO SQL

For SQL access, simply integrate Btrieve 6 with Scalable SQL, our award-winning relational database. Both are built on our MicroKernel Database Engine,™ which allows both navigational and SQL applications concurrent access to data.

NAVIGATE SAFELY WITH BTRIEVE 6.

Stories of time and money lost changing to client/server could fill volumes. With Btrieve 6, you can avoid the pitfalls. You'll have the control and convenience of using your own tools and writing in your own language. And you can add SQL technologies as required.

So navigate the safer route to client/server with Btrieve 6.

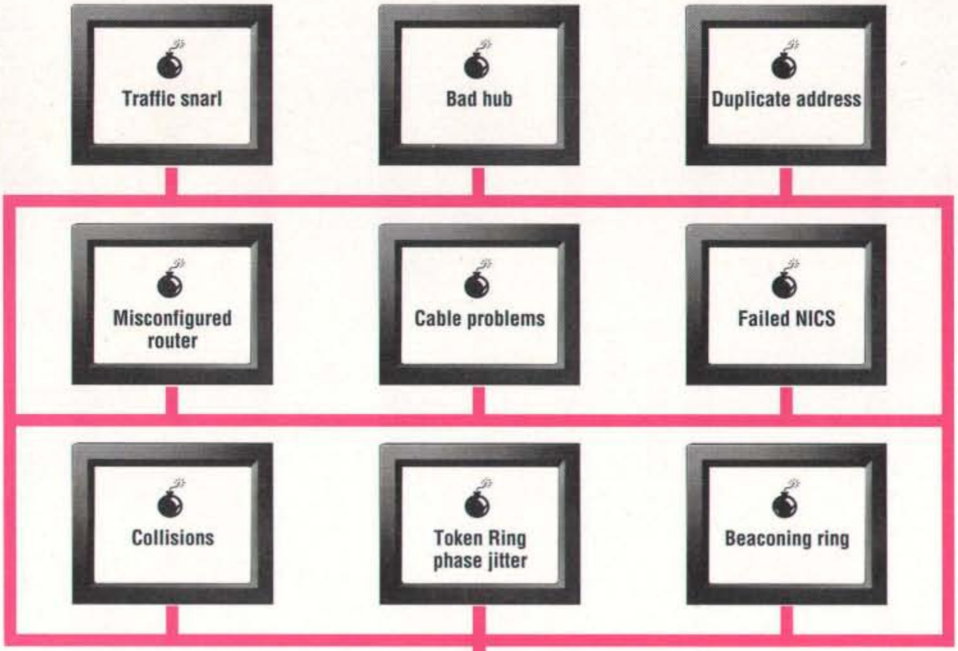
IT SIMPLY WORKS

BTRIEVE
TECHNOLOGIES

To receive a free white paper, call **(512) 794-1719.**

Circle 538 on Inquiry Card (RESELLERS: 539).

Tough LAN problems?



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Whether you're troubleshooting Token Ring, Ethernet or both, a Fluke LanMeter isolates all kinds of tough problems in seconds - from bad hubs to failed NICS, or misconfigured routers to faulty cables.

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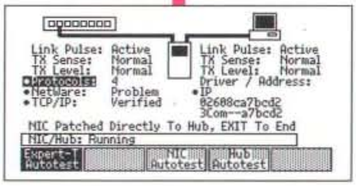

```
Link Pulse:  Active        Link Pulse:  Active
 TX Sense:   Normal         TX Sense:   Normal
 TX Level:   Normal         TX Level:   Normal
▪Protocols:  4             Driver / Address:
•NetWare:    Problem      •IP
•TCP/IP:     Verified      02608ca7bcd2
                           3Com--a7bcd2
 NIC Patched Directly To Hub, EXIT To End
 NIC/Hub: Running
```

Quick answers!

Austria	(1) 61410-0,
Belgium	02-331 27 77,
Denmark	43 44 1900,
Finland	(90) 5026 600,
France	(1) 4896 6363,
Germany	(0561) 95940,
Great Britain	(0923) 240511,
Greece	(01) 4894911,
Ireland	(061) 330333,
Italy	(02) 268 4341,
Netherlands	(040) 644100,
Norway	(22) 65 34 00,
Portugal	(01) 795 1712,
Spain	(91) 804 2750,
Sweden	(08) 751 02 30,
Switzerland	(01) 730 3310,

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For countries outside Europe, please call (1) 206 3565 500 or fax (1) 206 3565 116

Tools for Healthier LANs

FLUKE.

Circle 542 on Inquiry Card.

1994 BYTE AWARDS

The biggest stars of 1994 were enabling technologies. Many of last year's best products were the ones that will lead to this year's biggest hits.

Nineteen-ninety-four was a prelude of sorts. It set the scene for a dramatic act in which story strands entwine, mistakes are repaired, villains are vanquished, heroes are redeemed, truth is revealed, love is triumphant, and justice prevails.

The most significant developments of 1994 were enabling technologies—hardware and software that serve the needs of developers or that give users the kind of performance they require for the late 1990s. This includes such products as the Power Macs, which offer high performance at a good price. (We had expected to be voting on PowerPC-based computers from other companies, but that will be next year's story.)

General Magic's Telescript is another good example. This year we voted on the language itself; we expect to be voting next year on Telescript-based products.

In some ways, the past year was most notable for things we couldn't give awards to—things we thought we'd be voting on but couldn't, because they never came to market: namely, Microsoft's Chicago (aka Windows 95) and IBM's Power Personal PCs. We worked with beta versions of Chicago, and we had a preproduction PowerPC-based system from IBM, but we give awards only to products that are shipping.

We expect to be voting next year on a boatload of new RISC products. IBM will bring out its Power Personal systems, and other companies—including members of Taiwan's NewPC Consortium—will introduce their own PowerPC designs. The new chips and software that arrived this year point toward a big upswing in RISC products next year. Analysts at Dataquest predict that sales of RISC PCs will generate revenues of $7 billion in 1995.

PHOTOGRAPH BY FRANK CORDELLE © 1995

Power Macs and Pentiums

Far and away, the biggest vote-getter among the BYTE staff was Apple's line of Power Macs. Our enthusiasm for these new models was shared by the buying public: Apple has sold more than a million Power Macs since their rollout in March, thereby becoming the leading vendor of RISC systems. Analysts predict even higher sales in 1995, when owners of older Macs, new users, and some RISC converts snatch up Power Macs.

Our voting results also reflect the kind of year it was for x86-style desktop systems. You'll note that there are few of these machines in our list of winners. While many of the PCs that came out in 1994 were variations on the theme of faster and less expensive—a great theme—none of them broke new technical ground.

Killer Apps?

What was the piece of software you heard about most often last year? Chicago, probably. But what about shipping software? Chances are it was Doom, the grizzly game Jerry Pournelle describes as "heroinware." That's an indication of the kind of year it was in the world of popular software. In other words, there was no killer application.

Instead, we found the most excellent software to be outside the realm of mainstream and professional applications: The very best work was deeper down, in the world of development tools and operating systems. Our highest awards for 1994 go to platforms and software technologies that will enable the development of ground-breaking new products and capabilities.

Perhaps the most significant software arrival of the year—or at least the one that received the most votes from our staff—is General Magic's Telescript. So far, commercial use of Telescript has been limited to AT&T's PersonaLink service, Sony's Magic Link personal communicator, and the maybe-it's-arrived-by-now Envoy from Motorola. But some major communications companies, such as French Telecom and Nippon Telephone and Telegraph, say they'll use this language and its intelligent agents as the core of new, smart networks.

Another important enabling software that stood out on last year's timescape is Microsoft's OLE Controls. (We voted it the "most significant technology" as part of BYTE's Best of Comdex awards last spring.) OLE Controls, which combines OLE 2.0 with Visual Basic custom controls, will give developers tools for building a new generation of innovative programs.

Ninety-Five Will Be Smokin'

In some ways, the industry was in a holding pattern during 1994, waiting to see what would happen with new operating systems, such as Windows 95, and new processors, such as the PowerPC. The number of products that really knocked us out last year was down from the year before. But the things we liked, we *really* liked. They are significant technologies and products that are going to change the way we use computers.

Amidst all the spark and sputter of 1994, there were signs of a radical shift toward new processors, new operating systems, and new prototypes in software development. The components for major changes in computing are now in place. Ninety-five is going to be awesome. **—Compiled by Dennis Barker**

How We Picked the Best

We handle our voting process democratically. Every staff editor, as well as each contributing editor, is allowed to nominate what he or she thinks are the most significant products of the year. Being a multiplatform magazine, we are not limited by operating systems or CPUs: We are free to choose from the entire universe of personal computing.

When considering which products to nominate, we use these criteria: A product has to represent a new technology or break ground in terms of performance, price, or innovative use of an existing technology. Editors can nominate only those products that they have actually used.

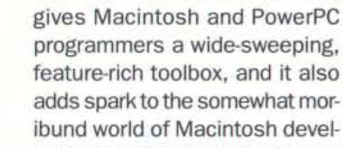
After the nominations are in, a ballot is compiled. Each voter then picks what he or she believes are the 10 best products or technologies on the ballot. Depending on how many votes an item gets, it receives an Award of Excellence, Distinction, or Merit.

AWARDS OF EXCELLENCE

CodeWarrior

Metrowerks

A top-notch multiplatform development system. The latest release of CodeWarrior, CW3, gives Macintosh and PowerPC programmers a wide-sweeping, feature-rich toolbox, and it also adds spark to the somewhat moribund world of Macintosh development packages, giving Symantec some competition.



CodeWarrior

CodeWarrior ships with Apple Extensions for 680x0 and PowerPC platforms, including AOCE (Apple Open Collaborative Environment), Drag and Drop, QuickTime, and the Threads Manager.

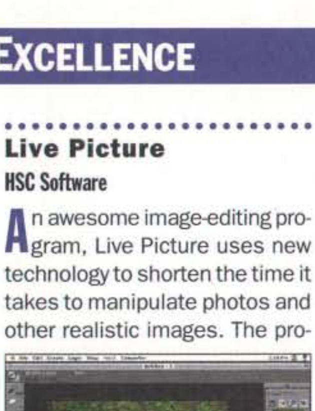
At the center of this package is the Integrated Development Environment, which is typical of all CodeWarrior tools: It's small and fast, and it does just what you expect. The system is flexible enough to allow every source file to contain multiple code segments—which is particularly useful when writing C++ and MacApp programs.

Some of our editors call CodeWarrior the package that saved Apple and the Power Macs, since it has been used by so many developers who are bringing their applications over to the new architecture.

Live Picture

HSC Software

An awesome image-editing program, Live Picture uses new technology to shorten the time it takes to manipulate photos and other realistic images. The program also uses a new image-storage format (developed by FITS Imaging, of Paris) that gives editing software fast access to any portion of an image at any zoom level. It's also got a slick airbrush and some nice special-effects tools. (See the review "Lively Pictures" on page 171.)



Live Picture

This program always draws big crowds when it's demonstrated at trade shows. You'll see why once you've looked at it, especially if you've ever worked with Photoshop or Picture Publisher.

Live Picture costs $3995; that's a lot more than what Photoshop and Picture Publisher cost, but it's peanuts compared to what high-end workstation products, such as those from Scitex, sell for.

Nx586

NexGen

The newest rebel entry in the War of the x86 Empire. NexGen's Nx586 is an 80x86-architecture processor; it supports all x86 instructions. When run on the Nx586, programs behave just

WINDOWS NT FLIES AT THE SPEED OF ALPHA ON ASPEN SYSTEMS.

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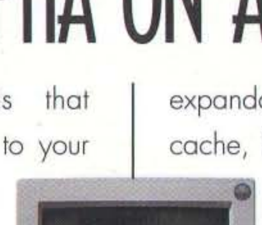

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as they do when they run on an AMD, Cyrix, or Intel chip.

What distinguishes the NexGen chip is its microarchitecture. It fetches x86 instructions from memory, but in the pipelines it executes RISC-like translations of x86 instructions. NexGen calls them RISC86 instructions and uses them to give the chip Pentium-class performance.

The Nx586 is a fascinating design. It demonstrates that x86-compatible chips don't need to replicate Intel's microarchitecture. And its price appears right (about $500 in lots of 1000, or about $200 less than what Intel's Pentium currently sells for; of course, that price difference could evaporate soon).

Athough seven motherboard makers and four system vendors have said they will use the NexGen chip, only one Nx586-based system has shipped thus far—the Alaris Nx586 VL. BYTE benchmarks show this system's integer performance is about 1.7 times higher than that of a 66-MHz 486, which is comparable to that of a Pentium-based Gateway 2000 P5-90. (See "NexGen's Come-from-Behind Strategy," November 1994 BYTE, page 30.)

As a design, the Nx586 is an outstanding accomplishment. Competing with mighty Intel in the marketplace is another story. But if AMD and Cyrix can do it....

OLE Controls

Microsoft

Componentware is the future. Tools that contribute to the construction of components are significant because they enable a shift to a new—if you'll pardon the expression—paradigm.

OLE Controls are important because they establish a generalized component model for Windows. In other words, OLE Controls will work with any OLE-aware application. In the past, VBXes (Visual Basic custom controls) were pretty much limited to Visual Basic. Other development tools added VBX compatibility, but only in a limited way, and it was something of a hack. OLE Controls are more general and aren't tied to the Visual Basic architecture. This opens up a larger market for third-party developers and also enables 32-bit controls. (VBXes are 16-bit only.)

PowerBook 500 series

Apple Computer

Apple gave the popular PowerBook a good overhaul with these new models—a good idea, considering the competition it's getting from IBM's hot-selling ThinkPads and Compaq's Aero.

The PowerBook's trackball has been replaced with an innovative trackpad. "It works much better than a trackball for text selection and editing, and it's better suited for drawing," says our Mac expert, Tom Thompson. Plus, since it has no moving parts, it's less likely to fail than a trackball.

These new PowerBooks use the 68LC040 processor, which is clocked at 66 MHz. However, the rest of the system runs at 33 MHz, so that's the level of overall performance that you can expect. Adding a second battery extends the length of time you can work away from a power plug. (BYTE's battery-life tests show the machine will run for about 6 hours on two fully charged units.) Or you can fill that space with an expansion card or Apple's PCMCIA expansion module.

PowerBook 500 series

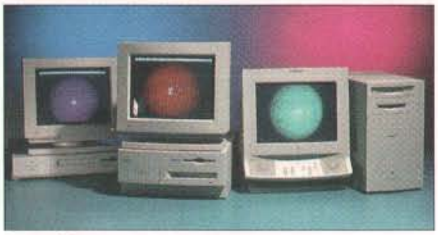
The PowerBook 500 series has substantial capacity for more memory and large hard disks. A built-in Ethernet port boosts the machine's network capabilities. The active-matrix color display used in the upper-end 540c model is excellent. The 520 comes with a passive-matrix screen, but you can swap in an active-matrix version if you want.

Since its debut, the PowerBook has set the pace for portables. The 500 line continues that tradition.

Power Macintosh

Apple Computer

With the Power Macs, Apple has made one of the smoothest technology shifts in history—and without forsaking performance, price, or compatibility. These new Macintoshes deliver plenty of horsepower, especially when doing floating-point calculations (vital for working with graphics and video).



Power Macs

BYTE's cross-platform benchmarks show that the low-end Power Mac 6100/60, which sells for $2200, performs comparably to a Pentium PC. And our low-level and application benchmarks show that the Power Macs don't need to hang their heads in the company of other RISC systems, either. In fact, in some applications, the 7100/66 and 8100/80 can keep up with workstations based on DEC's Alpha chip. The Power Macs will get even faster as more software houses move their programs to native code and as Apple ports more of the Toolbox to native code.

Apple has made some wise compromises in design. Cost-saving decisions, such as the inclusion of slow RAM, have been canceled out by performance-boosting features, such as the inclusion of a wider data bus and burst transfers. The hardware allows for faster systems in the future. Apple's engineers are to be commended for their farsighted approach.

These first Power Macs are proof that the PowerPC architecture has the right stuff to carry users toward the millenium. They've got the power to handle hungry data types, such as video. They will be able to accommodate a variety of new operating systems. And they cost less than most used cars. The Power Macs win our collective praise as the most significant computers of 1994.

Telescript

General Magic

This communications-oriented programming language enables the construction of smart networks. Telescript gives developers the tools they need to build intelligent agents and distributed networks. Eventually, there will be tools that allow ordinary users to create their own agents without programming (e.g., "Hello, Agent: Get me tickets to the Beatles reunion concert and find me a date for the evening.").

Because Telescript is a portable language that executes atop a run-time interpreter, applications can run without recompilation on any supported platform or network; it's not limited to systems that use the Magic CAP interface (which some of us find cartoonish). Telescript shields programmers from many of the complexities of network protocols and directory services. It addresses the major issue of security—agents, after all, are not much different from viruses—in several ways: Agents are encrypted, they have to pass authentication barriers, and their life span and capabilities (e.g., spawning) are regulated.

What PostScript did for cross-platform, device-independent documents, Telescript might do for cross-platform, network-independent messaging. So far, products and services using Telescript are few; using a Sony Magic Link in conjunction with AT&T's PersonaLink is the best available way to see Telescript in action. But with major companies such as French Telecom, Motorola, and Nippon Telephone and Telegraph pledging to use Telescript,

Cool Computer Upgrades.

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John Dvorak, *PC Magazine*, March 30, 1993
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Jerry Pournelle, *Byte*, April 1993

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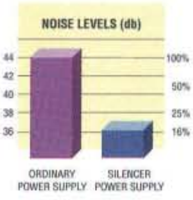

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"The only worthy upgrade [cases] I've found"
Ed Bott, *PC Computing*, October 1994

For an easy-to-build system, there's nothing like our economical **Personal Mini-Tower** enclosure. Features: small footprint, (3) 5-1/4" bays, (4) 3-1/2" bays (2 int.), a removable motherboard cage for easy assembly.
Specs: FCC-B, 16.7"L x 7.2"W x 15.5"H, 16lbs.

PERSONAL MINI-TOWER	**$79**

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Don't let PC fan failure cost you your system! Install our **110 TwinAlert** to detect overheating—*before* damage occurs. At 110°F, you'll get a loud audible alarm and a signal for optional network monitoring. And, if the computer is **unattended** and the temperature continues to rise to a dangerous 118°F, the TwinAlert will save your machine by automatically shutting-off its power! The **110 TwinAlert** is compact, easy to install, and compatible with any computer.

110 ALERT (audible alarm only)	**$19**
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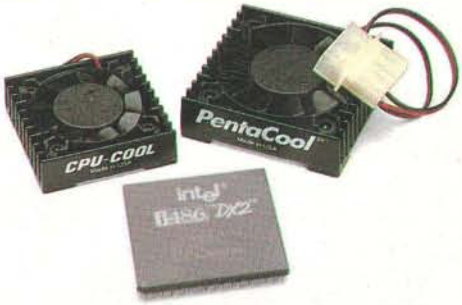
CPU COOLERS



It's a fact. 486 chips run hot, often exceeding 185°F! Now, you can cool your 486 to a safe 85°-95°F with our popular **CPU-Cool**. Consists of a long-life ball-bearing mini-fan inside a die-cast heat sink that easily mounts on the CPU. Powered by a spare drive connector. Effective, inexpensive insurance!

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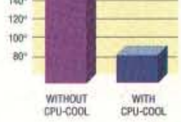

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it could become the lingua franca of worldwide telecommunications.

ThinkPad 755 series
IBM

A great pair of mobile PCs. Big Blue's 755C has one of the nicest and sharpest—and definitely the biggest—displays we've seen on a notebook: a 10.4-inch TFT (thin-film transistor) active-matrix screen. The smaller, dual-scan color screen on the model 755CS is sharp, too.

The list of standard features is impressive and includes 4 MB of RAM, a 170-MB hard disk, a full-size keyboard, PCMCIA support, 16-bit audio, and local-bus video with 1 MB of video memory. Buyers can choose between an Intel 75-MHz DX4 and a 50-MHz DX chip. Its RAM is expandable to 36 MB, and its storage capacity goes up to a whopping 810 MB, making this an excellent office computer as well as a powerful road machine.

IBM has thrown in lots of free software, and not just disposable junk, either; there's cc:Mail, Lotus Organizer, SofNet FaxWorks, and access to America Online.

Visual Voice
Stylus Innovations

At its core, Visual Voice is another VBX. Hook it up to the Visual Voice Workbench, though, and you've got a GUI environment for building a complete Visual Basic–based telephony application. As Rick Grehan wrote in his CodeTalk column in November, you can use Visual Voice to construct a program that can answer the telephone, send and receive faxes, play audio files, record audio to disk, decode Touch-Tones, hang up the phone, and "probably more things that I haven't yet discovered."

Inside the Visual Voice VBX are actions and properties that, with the proper hardware, allow your PC to perform all the actions mentioned above. Once you have gone through the process of assembling sound files, VBX routines, and Visual Basic code, the Workbench pours the appropriate BASIC code and proper connections to the VBX into the clipboard, so you can then hop over to your Visual Basic application and paste it all in.

Telephony programs will be some of the killer applications we'll see during this decade. Development packages like Visual Voice will make it easy to take advantage of the merger of PCs and telephones.

Windows NT 3.5 family
Microsoft

Jon Udell, a BYTE senior technical editor at large, describes the newest NT (aka Daytona) as a Mack truck. "It carries big loads for servers and serious business, scientific, and engineering users whose tasks justify powerful x86 or RISC workstations," he says.

The new version is slimmer than 3.1. Its performance-monitoring and event-logging services are sophisticated. Its multi-VDM (virtual DOS machine) Win16 capability works well, protecting Win16 applications from one another. Microsoft says Daytona will ensure reliable DDE and OLE traffic across VDM boundaries, and Jon's tests thus far indicate that this is true. And its performance certainly beats NT 3.1's. For users who have the iron and prefer security, reliability, and manageability, given adequate performance, Windows NT 3.5 is worth checking out.

Windows NT

AWARDS OF DISTINCTION

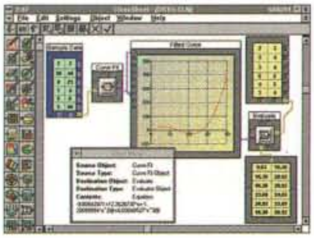
BJC-600
Canon

Like the Epson Stylus Color (see page 58), this is a printer that delivers sharp and vibrant color without bleeding cash. To our collective eyes, the Canon's color output isn't as rich as the Epson Stylus Color's. However, it's still very good, and the Canon BJC-600 is a great deal faster than the Epson at getting the ouput out. Even if you use color only occasionally, you certainly should take a look at this one when it's time to purchase a new printer.

Canon BJC-600

CleanSheet
Working Title

Objects made easy. CleanSheet is like a construction kit for grown-ups—grown-ups who want to build customized calculation applications without writing any code. You drag the parts (i.e., objects) you need from a palette and then link them together. Scientists, engineers, and financial modelers will find it a most useful tool.


CleanSheet

Collabra Share
Collabra Software

This groupware brings an easy-to-install, easy-to-use conferencing system to your LAN. With Collabra Share, users organize "forums" for discussion. The interaction isn't in real time; it's more like that of a BBS. Threads can include files, such as a spreadsheet, that everyone can comment on or edit. People not on the LAN can be included via regular E-mail. Collabra Share isn't Lotus Notes, but it's much simpler to install, use, and maintain. For certain workgroups, it's a good solution.

CorelDraw 5
Corel

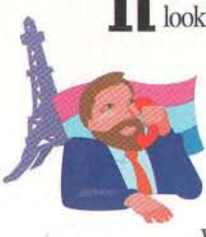
CorelDraw, which regularly sprouts new applications, gets better as it gets bigger. The newest version offers a run-time engine for the CorelShow presentation program, support for morphing in the CorelMove animation application, new lenses for applying photographic effects, improved color management, and a much-better Photo-Paint image-editing program, among other things. This is an all-in-one graphics shop.

DragonDictate for Windows
Dragon Systems

Dragon Systems has long been at the forefront of PC dictation technology. By delivering a software-only product that supports the most popular PC sound solutions (e.g., the Microsoft Sound System and Creative Labs' Sound Blaster), DragonDictate should propel speech-to-text dictation out of its niche and into the mainstream.

Folio Views 3.1
Folio

This Windows package is one of the best tools around for compiling and indexing massive amounts of text into a collection that can be quickly and easily searched. It's one of the tools that we use in the office to archive the text of BYTE articles.



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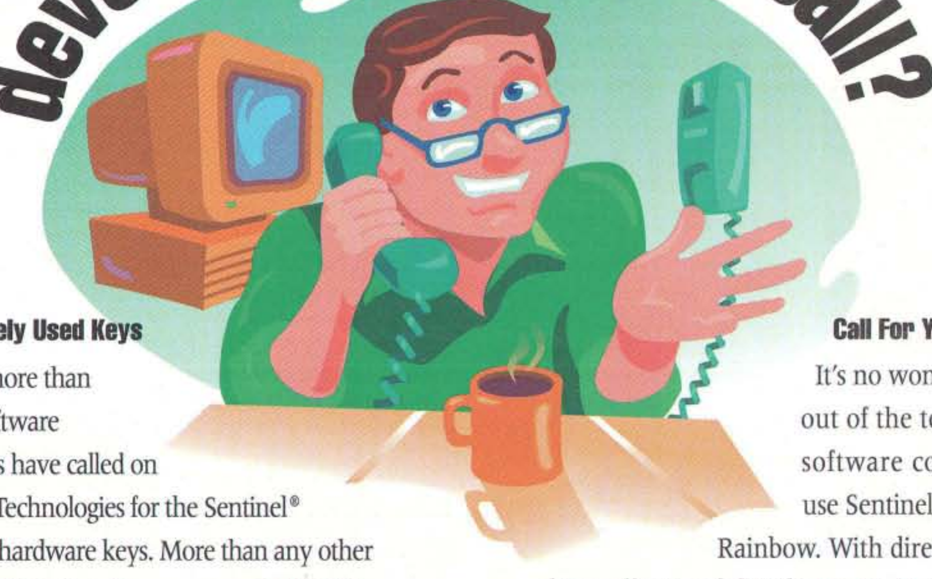

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It's true, more than 10,000 software developers have called on Rainbow Technologies for the Sentinel® Family of hardware keys. More than any other in the world. In fact, there are over 4,000,000 Sentinel keys in use today. That's because they are the most technologically sophisticated. Take the SentinelSuperPro™, for example. Featuring next generation ASIC technology, this key provides the highest security and most flexibility available. Anywhere. It's just one in a family of keys that support virtually any computer platform including Windows, NT, WIN32S, UNIX, OS/2, open systems and Macintosh.

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HP LaserJet 4M Plus

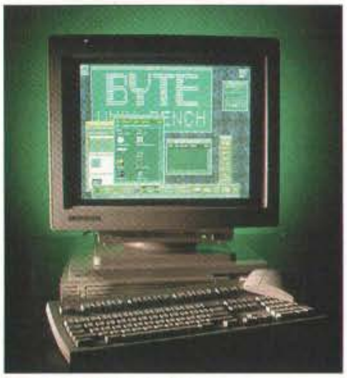
Hewlett-Packard

Our November 1994 Lab Report ranked this model as the best overall printer for general business use, calling it "a leader in the new generation of 10- to 12-ppm, 600-dpi lasers." It's easy to set up, can switch between PCL5 and PostScript, and can hold lots of paper.

HP 9000 Series 700 Model 712/60

Hewlett-Packard

Powerful Unix workstations at Pentium prices. HP uses innovative hardware packaging and the superscalar PA-7100LC CPU to deliver high performance in a system that's a good low-cost entry into workstation computing.



HP 9000 Series 700

IBM 0662 Model A10

IBM

A 1-GB hard drive. Although our benchmarks rated Micropolis's 1-GB Taurus 4110A drive slightly faster on most tests, no other drive had the Model A10's combination of high capacity, speed, and compactness. IBM's magnetoresistive head technology allows for smaller read/write heads and more dense packing of data on the disks (1 GB on three platters, whereas Micropolis uses five).

Kai's Power Tools

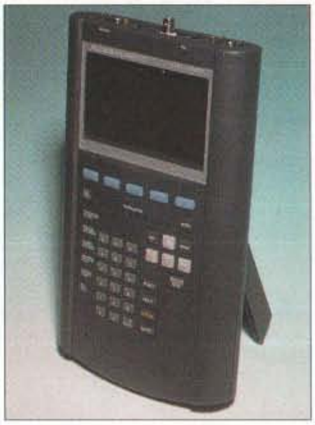
HSC Software

These Photoshop plug-ins extend the capabilities of Adobe's photo-editing program and simplify many of the complex operations. It's a good example of component software; you just plug it in and add features to an application.

LANMeter 675

Fluke

This handy problem solver—which analyzes and tests protocols, hardware, and cables—can replace a shelf of network-testing tools. Not only can the LANMeter display the distribution of network loads, but it can also show you the source of error packets and, on Token Ring networks, perform soft error-domain analysis. This 4½-pound device saves you from having to understand the low-level engineering of network communications and having to learn how to use a protocol analyzer.



LANMeter 675

LapLink for Windows

Traveling Software

With this program, Mark Eppley and company make the thankless task of transferring files about as easy as it can get. LapLink's remote-control utility is great, but probably the program's most impressive feature is SpeedSync, which transfers only those parts of a file that have changed (which helps lower those phone costs).

Myst

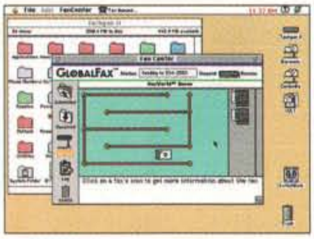
Broderbund Software

If you want to see multimedia put to effective use, check out Myst. This package's fantasy-world game might not be as addictive as Doom, but the development effort behind this CD-ROM adventure certainly deserves an award. The animation, background graphics, and design are brilliant. Along with the game, you get QuickTime movies that take you behind the scenes, showing interviews with the people who conceived and programmed this challenging diversion.

One World Fax Server

Global Village

This fax modem/software combination sits quietly on your LAN and provides shared fax-sending capability to any number of Mac users, taking up only one or two phone lines. A nice solution that sure beats printing out documents and then waiting in line at the office fax machine.



One World Fax Server

OpenDoc

Component Integration Laboratories

This cross-platform compound-document standard, backed by Adobe, Apple, IBM, Novell, WordPerfect, et al., aims to provide a way for users to work with information while operating on different platforms. Like the competing OLE 2.0, OpenDoc goes beyond compound documents to define a full-blown component architecture (see "A Close-Up of OpenDoc," March 1994 BYTE). OpenDoc parts can load dynamically, embed themselves in containers, and respond to commands issued from a variety of languages. Other notable features include vendor neutrality, support for nonrectangular content and multiple active objects, a scripting technology, and DSOM (Distributed System Object Model), which supporters say will give OpenDoc platforms a mechanism for packaging and distributing components.

OS/2 for Windows

IBM

With this version of OS/2, Big Blue has delivered a solution for people who want a 32-bit operating system that supports preemptive multitasking and multithreading while being able to run DOS, Windows 3.11, and native OS/2 applications on a relatively modest PC. It's easy for Windows users to get started with it because the operating system installs right on top of the Windows version that's already on their machines.

Photoshop 3.0

Adobe Systems

Adobe soups up the performance of its premier image-editing package; it's now significantly faster. Another welcome addition is support for multiple layers, which lets you place (and then work on) elements on different layers. The new Windows version supports multithreading under NT, so it takes advantage of dual-processor PCs.

Quicken Deluxe 4 for Windows

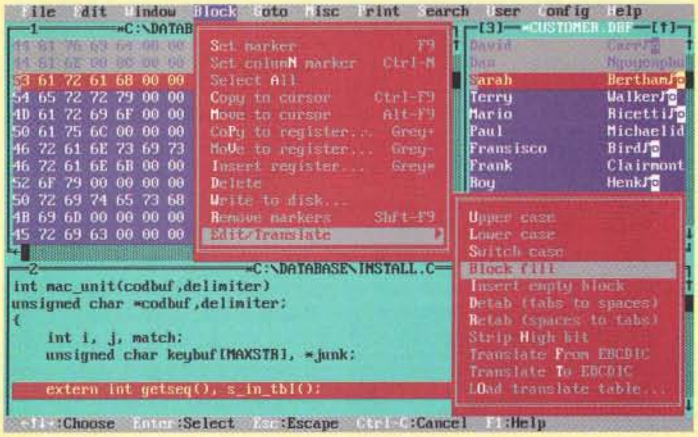
Intuit

Intuit upgraded the various versions of this top-selling personal finance program, making it easier for new users and more powerful for experienced users. Most impressive is the Deluxe 4 version for Windows. This CD-ROM lets you stroll through an office, library, and conference room to gather information (on, say, mutual funds). It includes special appearances by financial experts Jane Bryant Quinn and Marshall Loeb, who answer questions about investments and offer generalized advice.

Quicken Deluxe 4 for Windows

Without VEDIT you will soon be R.O.L. (Really-outa-luck)

STOP



```
44 61 76 69 64 00 00
44 61 6E 00 00 00 00
53 61 72 61 68 00 00
54 65 72 72 79 00 00
4D 61 72 69 6F 00 00
50 61 75 6C 00 00 00
46 72 61 6E 73 69 73
46 72 61 6E 6B 00 00
52 6F 79 00 00 00 00
50 72 69 74 65 73 68
4B 69 6D 00 00 00 00
45 72 69 63 00 00 00
```

```
David        Carr
Dan          Nguyenphu
Sarah        Bertham
Terry        Walker
Mario        Ricetti
Paul         Michaelid
Fransisco    Bird
Frank        Clairmont
Roy          Henk
```

```
int mac_unit(codbuf,delimiter)
unsigned char *codbuf,delimiter;
{
    int i, j, match;
    unsigned char keybuf[MAXSTR], *junk;

    extern int getseq(), s_in_tbl();
```

"I just received my copy of VEDIT PLUS and am very happy with it. I have occasion to edit files up to 40 megabytes, and haven't had a proper editor for it until now. VEDIT's speed is incredible. I ran through 20 MB of data today - VEDIT has quadrupled my production rate for this sort of thing already."

Bruce Numm, Los Angeles, CA

"I tell people that your products are superb, of course. But even more important, I tell them the conscientious support and consideration your staff give your customers is unmatched anywhere. Thank you for the generous support you have provided me over the years."

Ian A. Morton, St. Paul, MN

You may think that you already own a good editor. But if you don't have VEDIT, you don't have an editor that can edit **any** file. You may not know it yet, but you will. Someday. Probably soon. Under the gun of an important deadline. That you won't be able to meet.

For starters, some popular (and expensive) editors can't even edit "null", Ctrl-Z, or other control characters. With any binary/data file or even a corrupted text file you are R.O.L. (really-outa-luck).

Most editors can't handle lines longer than 256 or 512 characters. Get a file with 1000+ character long lines and you are again R.O.L.

Almost every editor comes to a crawl with files bigger than a few megabytes. That may sound big, but look around. How about that 20Meg Postscript file, the 50Meg database and the 500Meg file you're putting on CD-ROM. With your existing editor, you probably don't even consider them editable.

What about mainframe files without "newlines", or with EBCDIC characters. Or a dBASE file with fixed length records and a complex header. Can you edit them? Unless you have VEDIT, you are again R.O.L. Too bad if the entire project depends upon it.

VEDIT - The Universal File Editor

Only VEDIT can edit any file you'll ever encounter - control characters, long lines, huge files (up to 2 Gigabytes) and all. And it has special features for mainframe, database (e.g. dBASE .DBF) and CD-ROM files. With its incredible speed, it can quickly edit 100+ megabyte files that no other editor is fast enough for. For CD-ROM developers, VEDIT isn't just an editor, it's a life saver.

File modes support DOS, Unix and Mac text files, plus data files with fixed or variable length records. Display modes include ASCII, Hexadecimal, Octal and EBCDIC or any combination in a split screen. A user created translation table can be used for custom display modes or for translating the file itself.

Ultimate programmer's editor

VEDIT has every advanced feature programmers expect. Multi-file, multi-window editing, search/replace with regular expressions, parentheses matching, template editing, smart indenting, undo/redo, auto-save, block operations by character, line, file or column. The flexible compiler support integrates tools from different vendors. VEDIT also has convenient word processing and printing.

VEDIT PLUS

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Powerful macro language

The new C-like macro language automates repeated editing operations, performs file translations and is ideal for "filters". It permits "off-the-cuff" macros to be typed in and immediately executed; there is no time consuming compilation.

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VEDIT PLUS - DOS single user license: $149; DOS network 5 user license: $325. UNIX/XENIX, QNX: $285.

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Mail: P.O. Box 1586, Ann Arbor, MI 48106

Greenview Data

Circle 67 on Inquiry Card (RESELLERS: 68).

Silver Streak

Tut Systems

This $99 connector essentially turns plain old telephone wiring into 10-Mbps cabling—it's Ethernet without the thinnet. A Silver Streak LAN can have up to 30 Ethernet connections per segment. BYTE contributing editor Barry Nance set up and tested a Silver Streak network and remarked that "LAN packets flowed normally." When you add it all up, Tut's solution isn't less expensive than going with Ethernet cabling. But it's an innovative idea, it works, and it makes sense for small LANs.

Simon

IBM/BellSouth

This personal communicator combines a cellular phone, an 8600-bps fax modem, E-mail, cellular paging, and several productivity programs (e.g., a calendar, an address book, and a notepad) in an 18-ounce device that's the size of a slim walkie-talkie. Simon succeeds at being what it tries to be, which is not a personal computer but a mobile communications device.

Simon

SoftWindows for Mac

Insignia Solutions

This emulation package allows you to run DOS and Windows programs on a Power Mac. The speed isn't fantastic—it's comparable to that of a 386—but SoftWindows is a solid solution for folks who really have to run Windows applications on a Mac.

SparcBook 3

Tadpole Technology

Tadpole put a lot of thought into the design of this mobile system, reviewer Steve Apiki said in the August 1994 issue. It's the smallest and lightest (6½ pounds) of last year's wavelet of SPARC portables. (Sun's SparcStation Voyager is faster, but it weighs over 15 pounds.) Tadpole's Nomadic Computing Environment provides some network-configuration capabilities and a nice save-resume feature that stores the contents of memory when you shut down the system and then reloads it when you start it up again.

SparcBook 3 (right)

Stylus Color

Epson

It was a very good year for color ink-jet printers, with Epson and Canon both coming out with low-cost units that produce amazingly sharp color images. You've got to see the Stylus Color's output to believe it. You've also got to wait a while to see it; speed is not this printer's forte. But its price is so low (around $600) that it'll make you wonder why anyone would buy a black-and-white model.

Stylus Color

System 7.5

Apple Computer

The latest Mac OS, for both 680x0 and PowerPC systems. Strategic new elements in the interface can improve a user's productivity. Important additions, such as the Thread Manager, enable developers to tailor their applications to exploit features in the future Copland release.

TMS 320C80

Texas Instruments

Developers and analysts raved over this DSP (digital signal processor). One called it "the god of DSPs." The chip, also called the MVP (multimedia video processor), integrates four 64-bit DSPs, a 32-bit RISC CPU, dual video controllers, a DMA controller, and 50 KB of static RAM onto one chip. TI says it can handle 2 billion operations per second. The 320C80 should start showing up in high-end video boards, image processors, and videoconferencing systems soon.

V.34 technology

Motorola

Although Motorola Codex's 3260 Fast device didn't win the top spot in our July 1994 Lab Report on V.34 modems (Hayes's Optima 28800 V.FC + Fax did), it did score the fastest in the impaired-line test. Travelers who've had to deal with lousy phone lines at hotels and airports will appreciate this. Plus, Motorola is one of the few modem makers that doesn't charge you extra for upgrading to V.34. That, in our opinion, deserves kudos.

AWARDS OF MERIT

Access 2.0

Microsoft

With new features that make it easy to learn and use, together with enhanced development tools, this object-oriented relational database can serve dabblers as well as developers.

Contura Aero 4/33c

Compaq

The Kate Moss of notebooks. This svelte color unit weighs only 5 pounds even with its optional external floppy drive, battery pack, and adapter. If it had a better screen than its passive-matrix display, this would be a killer notebook.

CorStream

Artisoft

A high-speed NetWare 4 server with the easy-to-use LANtastic interface. One of the best products to be shown at Spring Comdex 1994.

The Debugger

Jasik Designs

If you want to do serious source code and assembly language Macintosh programming, this is the debugger you need. It supports both 680x0 and PowerPC assembly language and source code deinfestation. The Debugger's ability to display and debug two processor instruction sets simultaneously is an extraordinary piece of programming.

DM-5028 DoubleSpeed Plus

Plextor

This unit was rated the best overall double-speed CD-ROM drive in our September 1994 Lab Report for its excellent combination of speed and price ($409). It led the pack in text-searching speed and came in second in sequential-throughput speed.

Internet-in-a-Box

Spry/O'Reilly & Associates

One of the slickest programs for pointing and clicking your way through the data jungle. This kit simplifies accessing the Internet from your Windows PC. It includes Spry's FTP, Telnet, Gopher, mail, news, WAIS (Wide Area Information Service), and Mosaic tools, as well as O'Reilly's Global Network Navigator.

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Electric Utility Week
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Hazardous Waste Business
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Inside F.E.R.C.
Inside N.R.C.
Integrated Waste Management
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Modern Plastics
Nucleonics Week
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Platt's Oilgram News
Platt's Oilgram Price Report
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Quadra 630

Apple Computer

One of the best multimedia machines there is, with built-in video support and a TV tuner if you want it. Affordable, too.

Quadra 630

RAM Doubler

Connectix

A cool system utility that effectively doubles the amount of RAM available to Mac applications; it uses a neat data-compression mechanism.

SoftBoard

Microfield Graphics

This $2995 conferencing peripheral looks like a standard whiteboard. But it also displays the written information simultaneously on a PC or Mac hooked in via a modem and a phone line. Great for meetings with people in remote offices.

TD-4 Personal Workstation

Intergraph

Two 90-MHz Pentiums in a box, with a high-performance graphics subsystem. Perfect for CAD, modeling, and NT applications.

T4800CT

Toshiba

The Cadillac of portables. The Windows notebook of choice if you're willing to pay $6400 for speed (the system has a DX4/75 CPU), long battery life (5 hours), and a very sharp color display. It makes a nice desktop replacer.

Toshiba T4800CT

TrueSpace

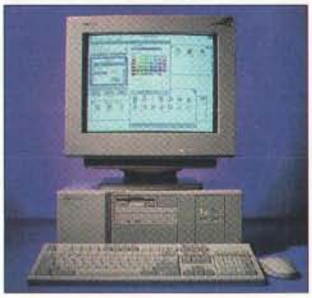
Caligari

If you've wanted to try 3-D illustration but were daunted by the idea of learning how to use a complex CAD-type program, check out this Windows package.

Vectra XU 5/90C

Hewlett-Packard

A 90-MHz Pentium PC with a design that our testers found "well-considered." The XU offers IDE and SCSI-2 storage, networking, and video acceleraton (via an S3 chip) integrated on the motherboard via the PCI bus. Take the top off, and it's easy to access the components.



Vectra XU 5/90C

Watcom C/C++ 10.0

Watcom

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The Newton Goes

ANDY REINHARDT

Downsizing is a euphemism for the laying off of employees, but it's also a clarion call to management to work smarter and more efficiently with fewer people. The telephone companies of the U.S., transitioning from a quasi-public monopoly to fiercely competitive private entities, have had to do a lot of both in the past 10 years, and there's more to come.

The dirty little secret of labor reduction, however, is its enormous price in loss of collective knowledge. Workers who have honed their expertise, sometimes for decades, are suddenly gone, taking with them a refined understanding of problems and solutions.

The only way for companies to preserve that legacy while reducing their employment ranks is to attempt to capture such wisdom in software, using expert systems. This need, coupled with the growing complexity of the phone system and the drive to boost productivity, is spurring a new wave of automation at local and long-distance telephone companies.

Norm Schillaci, SuperTech 2000 product manager for Dracon and the project's engineering development leader.

PETER LOPEZ © 1995

Considering how advanced the phone networks are, their operations are remarkably low-tech in certain labor-intensive areas, such as field service. Until recently, repair technicians often got their assignments over the phone from a central dispatcher (a practice that's still common at smaller independent firms) and later filled out paper forms to record the results of service calls. These forms were then manually rekeyed into mainframe computers for tracking and analysis. Even now, technicians can complete just three to four jobs per day, on average.

Phone companies are now trying to drive automation from the regional data centers into the hands of so-called *craft technicians*, the people in the yellow hard hats who test and repair phone lines. There are an estimated 100,000 such professionals in the U.S. alone, and as many as half a million worldwide. Considering that they work on and around phone lines, their efforts don't currently take full advantage of the communications infrastructure that's literally at their fingertips.

Harris/Dracon aims to boost its phone-repair productivity with a custom-designed, ruggedized Apple Newton MessagePad

Firms that supply equipment to telephone companies are now being pressed into designing for downsizing: Telephone companies are seeking products that will enable them to automate field tasks, reduce their labor costs, and improve the overall work quality. One such supplier is Harris (Melbourne, FL), whose Dracon division, located in Camarillo, California, designs and manufactures telephony test equipment. An early player in *CATs* (craft-access terminals), pocket PC–like devices that let line workers dial into service offices for dispatch instructions, Dracon has now struck out in a new direction with a hand-held computer that is based on, of all things, the Apple Newton MessagePad.

Dracon's ruggedized, custom-designed version of the Newton handles dispatch and other craft-access functions, and it also automates job tickets and results reporting through easy-to-use screen forms. But its biggest benefit is the intelligence that it delivers into the hands of field technicians. The Dracon SuperTech 2000 CDA (craft digital assistant) automates test procedures, delivers on-line help, and provides access to the repositories of data, schematics, and expertise that were formerly carried by hand or in the heads of workers—or were inaccessible in the field. How Dracon progressed from its original vision of a hand-held system to the notion of customizing the Newton is a revealing tale about developing targeted solutions.

The Dracon CDA also represents a major step in Apple's effort to reposition its maligned PDA (personal digital assistant) as a vertical-market tool. (Industry wags quip that vertical markets are where failed consumer electronics go to die; however, the

Vertical

Newton's situation probably isn't so dire.) Dracon's application is a desirable, high-visibility one for Apple: It involves blue-collar workers, harsh environments, and the potential for substantial productivity payback. If Apple and Dracon make this application fly, it could be a model for other vertical-market products.

Both Apple and Dracon have the opportunity to apply the technologies of Dracon's CDA to other areas. For example, their nonexclusive arrangement allows Apple to leverage off Dracon's work in ruggedizing the Newton. This could help it sell in other demanding environments, such as oil-field exploration, mining, shop-floor control, utilities, and governmental services (e.g., emergency response, traffic and parking control, census taking, and public health).

Meanwhile, Dracon chose to use the Newton partly because of its object-oriented software environment. Although Dracon's software is now focused on telephone repair, its templates, scripts, and communications capabilities are generalizable and reusable. Dracon hopes to eventually provide these software tools to other firms customizing the Newton for field-service applications.

Testing the Loop

Dracon is a major player in the market for line-testing and conditioning equipment in the *local*, or *subscriber*, loop, that part of the phone network located between the customer site and the CO (central office), with products such as the DATU (direct-access test unit) Loop Conditioning System. The company began the project that led to the birth of the SuperTech 2000 CDA more than three years ago, before the Newton was even announced. The project's roots go back even further—to 1987, when Dracon expanded from microprocessor-based test equipment into the market for hand-held CATs, which were pioneered by AT&T and Bellcore.

Line testing and conditioning are essential aspects of POTS (plain old telephone service) because analog circuits are so subject to quality degradation. To ensure an acceptable level of sound fidelity, technicians have to find failed components or line breaks and eliminate noise in the circuit.

Before the advent of such devices as the DATU, these tests were performed by two people, a technician in the field and a partner in the CO. The field technician carried a large phone-like device called a *butt set* (named for its ability to butt in on a line) and an assortment of analog meters for testing voltage and current. He or she would call the CO, ask a worker there to provide a test frequency or sequence of tones on the line under test, and measure the results. This iterative process was easily bottlenecked when CO workers became overburdened.

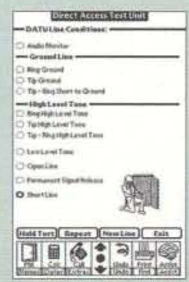
The DATU eliminates the need for a technician in the CO, because the field technician can call from the butt set directly to an interactive test system and use DTMF tones to control it. The DATU resides in the CO. Using tones, the field technician orders it to switch onto a specific line and then call back, perform

BRINGING AUTOMATION TO THE FIELD

The Challenge

Harris/Dracon's customers, the phone companies, wanted to:

- Reduce the size of their field-service work force and boost productivity above the average of three jobs per day.
- Move their data-processing workload away from central offices and into the field.
- Break away from proprietary host/terminal systems and move toward an open client/server model.
- Improve their overall work quality through the use of expert systems.



Direct Access Test Unit

DATU Line Conditions:

☐ Audio Monitor

Ground Line

☐ Ring Ground

☐ Tip Ground

☐ Tip - Ring Short to Ground

High Level Tone

☐ Ring High Level Tone

☐ Tip High Level Tone

☐ Tip - Ring High Level Tone

☐ Low Level Tone

☐ Open Line

☐ Permanent Signal Release

● Short Line

The Response

These requirements propelled Harris/Dracon to:

- Customize an inexpensive, mass-market hand-held system instead of designing a niche product.
- Build a communications system involving both local- and wide-area wireless networks.
- Obtain as many components as possible through licensing instead of rolling their own.

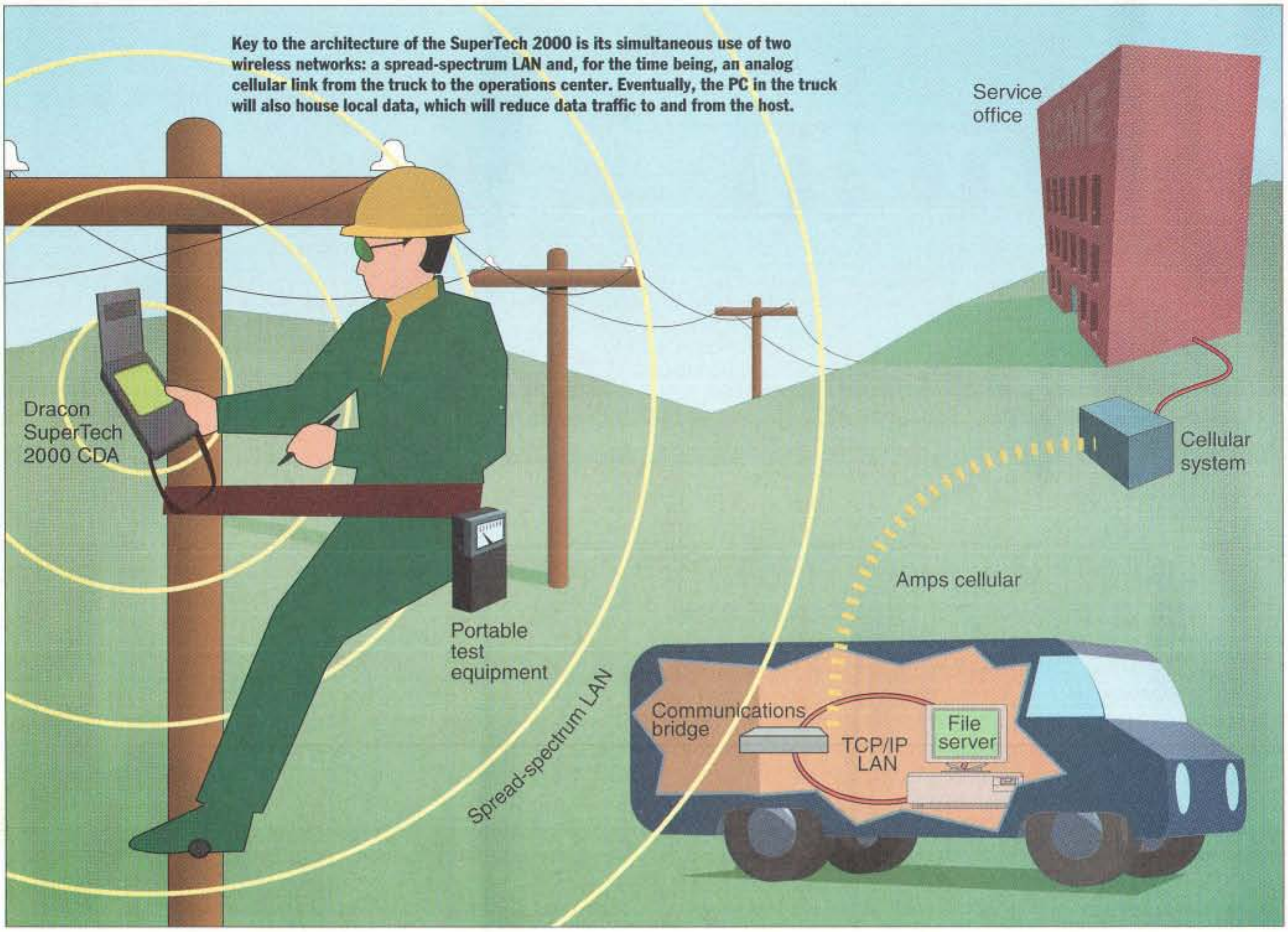
The Outcome

- The core Newton was wrapped in a tougher case and a protective rubber boot, fitted with backlighting and wireless networking capability, and loaded with software to automate phone-line tests and repair tasks.
- Dispatch, reporting, and job-ticket closure are simplified and speeded up.
- Expert-system software makes it easier for technicians to conduct complex, iterative tests and productively use a variety of third-party devices.
- Distributed servers will eventually off-load schematics, network diagrams, and customer profiles from central hosts.

Lessons Learned

This experience demonstrates that:

- New platforms carry inherent risks: The Newton hasn't fared as well in the market or attracted as much third-party support as was originally expected.
- Harris/Dracon was surprised and disappointed by the paucity of development tools for the Newton but believes the situation is improving.



Key to the architecture of the SuperTech 2000 is its simultaneous use of two wireless networks: a spread-spectrum LAN and, for the time being, an analog cellular link from the truck to the operations center. Eventually, the PC in the truck will also house local data, which will reduce data traffic to and from the host.

diagnostic sequences, or provide a set of frequencies.

But the process is still a bit like detective work, which is why clever humans are needed to complete the process. Most craft technicians used to have only high-school diplomas; now, because of more complex digital telephony, some companies require them to hold an associate degree or pass a test. And technicians typically spend a few weeks every year being retrained by AT&T and other phone-equipment suppliers.

When telephone companies first set out to automate field service, their first line of attack was improved dispatching. Repair workers make between $15 and $30 per hour, depending on their specialties and skill level, so one of the imperatives was to send out the right person for each job, not somebody who's improperly qualified. To improve labor deployment efficiency, telephone companies implemented expert systems in their OSS (Operational Support Systems) centers, which are regional facilities that oversee many COs. Among the information housed at OSSes are so-called *outside-plant records*, which are schematics of wiring plans, maintenance histories, and databases of customer-service options (i.e., whether customers have selected services, such as call waiting, caller ID, or voice mail).

When a service problem is first reported, the OSS conducts an initial automatic test through the lines. Computers in the OSS ask loop-based equipment to access a physical circuit, and the OSS then tests such factors as voltage, amperage, resistance, and capacitance on the line. These measurements are fed into host-based expert systems that compare the findings with problem profiles and provide a basic analysis of the fault. From this data, dispatchers estimate the kind of technician that needs to be sent out; this saves money right off the bat if the problem can be solved by a junior person, and it shortens the repair time required if the problem requires a more specialized person.

The second method used by telephone companies for improving labor deployment efficiency was to issue dispatches by computer instead of verbally. Field technicians were given small CATs, typically computers with built-in 1200-bps modems, that they could use to tap into a line and receive marching orders. These devices were usually proprietary, character-based terminals and relied on centralized host systems in the OSS (most of which were initially DEC PDP-11s and VAXes and, later, Unix-based minicomputers). Nowadays, CATs are more typically DOS-/x86-based hand-held PCs.

In 1987, Dracon introduced a state-of-the-art CAT built around a pair of CPUs (an 8086 and an MC 6502) and a heated, backlit LCD. But the market failed to develop, and the company dropped the product in 1989. According to Norm Schillaci, SuperTech 2000 product manager for Dracon and leader of engineering development for the project, CATs posed numerous architectural problems. As terminals, they were reliant on the host, which afforded little opportunity for distributing processing power. In fact, telephone companies preferred that CATs not be too intelligent; this kept prices down and minimized the cost of replacing any that were lost or damaged.

One advantage of this approach, of course, was that new features could be implemented centrally instead of requiring individual devices in the field to be reprogrammed. Unfortunately, CATs also

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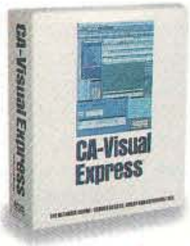

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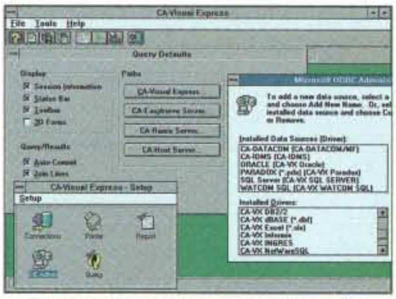

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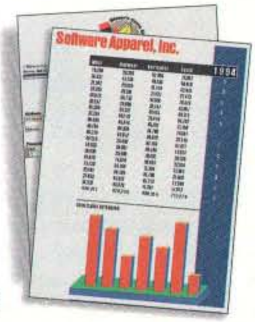

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provided limited information to craft workers, and users needed training to master their arcane syntax.

A confluence of forces led Dracon to its next solution, which eventually became the SuperTech 2000 system. The first factor was the soaring amount of computer power that could be built into tiny devices, which made the use of traditional terminals indefensible in price/performance terms. The second factor was anticipation of demand for client/server solutions: While telephone companies wouldn't dispose of their OSS hosts overnight, breaking the hard coupling between back-end systems and field devices was an attractive first step. Third, the downsizing imperative and growing complexity of both the network and testing procedures dictated the need for smarter, easier-to-use field devices.

Dracon conceptualized a new hand-held system that united some of the functions of a test meter, a butt set, and a CAT and added job-ticket processing, on-line help, and built-in expertise. This vision required a general-purpose computer platform because it had to be programmable, yet it also had to meet some stringent physical characteristics (e.g., small, lightweight, battery-powered, and rugged).

The need for ease of use, which meant getting rid of all the cryptic text commands used on CATs, drove the adoption of a user interface built on forms, check boxes, pick lists, and pull-down menus. Using a smart mobile device with a GUI would let Dracon hide the legacy systems in the OSS without requiring telephone companies to scrap or retool them.

Another key early decision was to use wireless technology to connect the mobile device to other systems. One drawback of CATs is that a physical connection to a wire must be made to download service calls. Every time craft technicians attach a CAT to, or disconnect it from, the wires, they stress the physical connection points of both the phone system and the CAT. A wireless system not only avoids this problem but also permits the exchange of data when the craft technician is driving between job sites.

Ironically, wireless technology also offers greater data bandwidth than current CATs (i.e., 56 Kbps or higher, versus 1200 bps). At the same time, Dracon decided to implement a wire-line modem in the CDA as a backup in case the wireless system ever went out of commission.

The Long Road

Field devices used to be proprietary, says Dracon's Schillaci, but a few years ago, phone companies started issuing RFPs (requests for proposals) for DOS-based systems. "It wasn't that DOS was any better; it was that they [phone companies] were afraid of being boxed in by a closed system," he says. "They wanted the option of running third-party programs on these devices instead of relying on what the vendor supplied. And they wanted to be able to develop their own apps."

In 1991, Dracon began looking at general-purpose platforms on which to build its combo unit. The first contenders, DOS-based pen computers from Grid Systems (which is now owned by AST), didn't fit the bill. Schillaci says that while these systems were sufficiently ruggedized, they were too heavy, didn't have a long-enough battery life, and were too expensive. Furthermore, he says, their software tools and operating environment (DOS plus the PenRight shell) weren't robust enough for the target customer base and usage profile.

The telephone companies are attempting to drive automation from regional data centers into the hands of the people wearing the yellow hard hats.

—Norm Schillaci, SuperTech 2000 product manager for Dracon and the project's engineering development leader

Dracon also considered building its own DOS-based system from scratch but ruled that out because of high development and manufacturing costs. "We are not in the business of making general-purpose computers," Schillaci says. The company also rejected the idea of supplying an off-the-shelf (or an environmentally hardened) laptop for use in conjunction with a CAT, because this would have required technicians to carry two devices while in the field. The whole point was to roll all the necessary functions into a single system.

Looking at options other than DOS-based systems, Dracon considered, and eliminated, several of them. The Eo systems, which ran the object-oriented PenPoint operating system on AT&T's Hobbit chip, were cast out for being too big and too costly. "The Eo had lots of integration [i.e., built-in cellular capability and a rich software environment], but it was heavy and very expensive," Schillaci says. "We saw it as a real disaster, and an analyst recommended against it." Systems running General Magic's Magic CAP or Microsoft's WinPad looked like they would not be ready soon enough. (As it turned out, the Newton shipped more than a year before the Sony Magic Link did, while the first WinPad systems are yet to be delivered.)

When former Apple head John Sculley announced the Newton, with its entry price of just $800, Dracon was impressed. "We went, 'Wow!'," Schillaci says. But equally important were Apple's image and attitude. "Lots of people were trying to figure out what a PDA was, but Apple had come the closest," he adds. "They had set up their own division. They had a reputation for being a pioneer. And they had signed up a lot of third-party partners, like Motorola and Toshiba." And, he notes, a consultant told Dracon that he expected only two pen/PDA environments to succeed over the long haul: the Newton and the WinPad.

Although the Newton was aimed at the consumer market, Dracon decided to tailor the device for a vertical application. A key factor in this decision was the object orientation of the Newton operating system, which Dracon believed would make two things possible: the reuse of code and easy third-party licensing of software components. This meant not only that Dracon could obtain software functions from other firms rather than inventing them from scratch (e.g., the SuperTech 2000 CDA can use VT100 terminal-emulation software from Ex Machina [New York, NY]) but also that Dracon could sell the forms and procedures it created (e.g., a job-ticket template or a script for managing test procedures) to other vertical-market players. For these reasons, concluded Schillaci, "We decided that going with the Newton was the safest thing."

Customizing the Newton

Dracon's original intent was to use an off-the-shelf Newton with an external communications module connected via the LocalTalk port; the target weight for the whole package was 2½ pounds, with an operating life of 8 hours per charge.

But problems emerged quickly. A wide variation in field-lighting conditions dictated that the display be backlit, which would use up more energy and require retrofitting of the unit. More important, the Newton's packaging—especially its unprotected screen surface—was not up to Dracon's environmental specifications. Among the problems: the degree of safety from precipitation, the quality of the seals,

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and the placement of the speaker (see the table "Environmental Requirements for the Dracon SuperTech 2000 CDA"). For these reasons, Dracon decided to design a customized version of the Newton.

The SuperTech 2000 CDA is based on a standard Newton core, using the same main printed circuit board as the Gelato (i.e., MessagePad 120) release of the product. However, there are differences between the two models: Dracon's CDA has stronger plastic and a different case, is slightly thicker than the Newton, doesn't have an infrared port, and has a different silk screen over the LCD. The screen is also covered with a Mylar shield, and there is a door to cover it when the device is not in use. Also, the entire system is enclosed in a rubber boot to further protect it against breakage.

In addition, Dracon has added backlighting behind the LCD and incorporated a new "fuel-gauge" battery technology, which features a microprocessor in each battery pack that manages different power and recharging characteristics transparently to the system. This will allow seamless migration from the nickel-metal-hydride batteries the CDA uses today to more efficient lithium-ion batteries in the future. The Dracon CDA doesn't include an AC adapter because it's intended to be used only on battery power and recharged on a supplied charge stand when not in use. Schillaci says that one reason Dracon chose both the Newton and the wireless technology offered by Digital Ocean (Lenexa, KS) was their respective power management capabilities, compared to other options.

The Dracon SuperTech 2000 CDA uses Apple's Newton technology wrapped in a more rugged case and enhanced with backlighting, built-in wireless communications, and an improved battery. Apple is free to incorporate these changes into other vertical-market implementations of the Newton.

Environmental Requirements for the Dracon SuperTech 2000 CDA

Storage temperature range	–40°C to +66°C
Operating temperature range	–20°C to +44°C
Thermal shock resistance	Unit will operate for 1 hour after ambient temperature change of –40°C to +21°C or +21°C to +66°C
Water resistance	Unit is splash-resistant but not submersible
Physical shock resistance	Unit can withstand multiple drops from up to 6 feet

The CDA itself is only part of the SuperTech 2000 system, which also includes communications components for linking the Newton back to the CO and OSS. Built into the hand-held unit is a wireless LAN based on Digital Ocean's spread-spectrum technology, used for talking to a communications bridge located in the technician's truck or in a satchel. This wireless LAN can also be used to interface portable test equipment to the Newton (more on this later). The communications bridge, in turn, communicates to the service center via a wireless WAN; for now, Dracon is using analog cellular technology, but eventually it could employ CDPD (Cellular Digital Packet Data), packet radio, satellite, or some other emerging technology.

Digital Ocean's wireless LAN has a range of 800 feet and operates in the 902- to 928-MHz unlicensed frequency range. Instead of frequency hopping, it employs direct-spread radio technology, which Dracon says uses less power and allows for a potential throughput of up to 2 Mbps (although, due to software overhead in the Newton, the actual rate is now closer to LocalTalk rates of 234 Kbps).

Analyst Ken Dulaney, of the Gartner Group (Santa Clara, CA), points out that direct-spread technology is more subject to external interference than other technologies. But because the nature of Dracon's transmissions isn't very confidential and the signal range is fairly short, security is not a big factor.

Dracon chose to adopt this two-level communications architecture instead of equipping each CDA directly with a wireless LAN (either on a PCMCIA card or built in) for several reasons. First, the wireless LAN creates a distributed communications hub surrounding each truck that is capable of supporting more than one repair technician. This helps push the work load away from service centers and into the field, reducing the data traffic going in and out of the OSS. It also breaks timing dependencies between mobile devices and host systems: The CDA doesn't have to have real-time access to the host, which permits greater flexibility on both sides of the communications link.

Second, the LAN also supports non-CDA devices. This means that makers of portable test equipment can equip their products with compatible radios and then link them locally to the CDA.

Third, the wireless LAN uses less energy than a WAN and operates at a higher data rate. To a certain extent, it also protects Dracon's customers against the risks of evolving wireless-WAN standards: Rather than having to change every unit in the field to support a new technology, they only need to update the more easily replaced interfaces in the communications bridges. Of course, a wireless WAN card could still be installed in the Newton's PCMCIA slot by the customer.

The notion of a communications hub is central to Dracon's long-term vision for the SuperTech 2000. For the time being, the truck-based bridges (which are likely built on DOS- or Unix-based x86 computers) are mere relays that shuttle LAN traffic back to the service centers. But they will eventually become, or be attached to, distributed servers containing some of the "outside plant" information that's now housed at the OSS.

Thus, when a craft technician wants to see a wiring plan or look up a customer's service profile, the data transmission can occur locally and at faster LAN speeds instead of at slower WAN rates. Forms, templates, and customer information can be maintained in the servers and updated via periodic downloads from the service center. Job tickets can be distributed in batches each morning in real time and then collected when each job is completed, instead of on demand.

Using the CDA

Third-party players will determine how much of the craft technician's work is eventually integrated into the Dracon CDA. Initially, the repair technicians will still carry portable test equipment around with them, so the actual measurement of voltages and frequencies won't be done by the Newton. But over time, these functions could be brought under the CDA's umbrella or even designed into PCMCIA cards. To encourage such integration, Dracon will publish the HAPI (Harris API) specification, which outlines the roughly 50 function calls and 50 frames and templates that it has added to the Newton environment.

The closest kind of integration would make use of either the wireless LAN or the CDA's RS-232 serial port. Makers of

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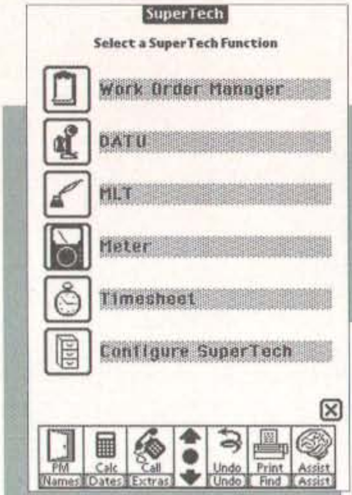
portable test equipment, such as CTC, Tektronix, and 3M, could reengineer their devices to contain a wireless LAN or serial interface and then develop Newton-based software to access, configure, and control the device. The result would allow a craft technician to receive work orders, perform tests using third-party devices, incorporate measured results into reports, and close job tickets from a single user interface. So far, no test-equipment makers have publicly committed to supporting the Dracon CDA, but the company is working closely with four major players, of which it expects at least one to attach a device via serial and another via the wireless LAN.

If this third party doesn't want its product to directly connect to the CDA, there's another possible integration option: supplying Newton-based support software. A device maker could provide instructions on how to control and configure its product; advice on how to interpret results; or even forms into which to enter measurements for analysis, incorporation into a report, transmission to the OSS, or input to an expert system.

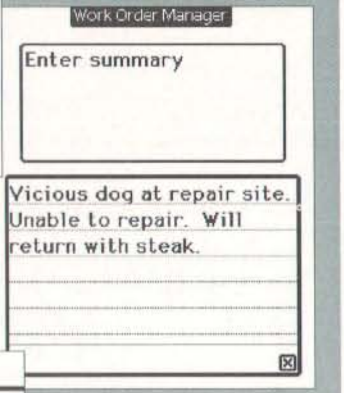
According to Schillaci, all the programs that are now in development for the CDA are graphical and "tappable." If any text entry is required, they use an on-screen keyboard for hunt-and-peck text entry, not the Newton's handwriting recognition. (There are also applications that use digital ink; more on this later.) Changes to applications can be downloaded to flash memory.

Certain Newton functions, such as the Intelligent Assistant, will not be available for craft-technician applications. But other built-in capabilities, such as the ability to record names and addresses, will be. In addition, data values that are created and used by CDA programs won't be accessible to normal Newton applications, so the data can be protected from corruption.

SuperTech 2000 Software



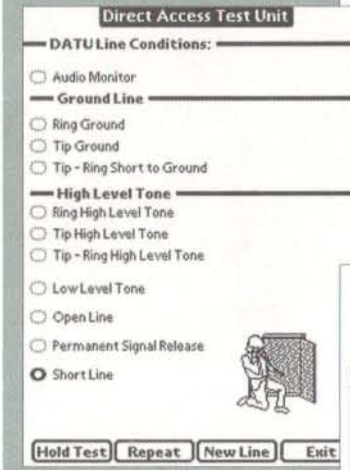
The main screen of the suite is called the Presentation Manager. From this starting page, craft technicians can receive work orders, perform direct-access and multiline tests, and interface to third-party meters. ◄



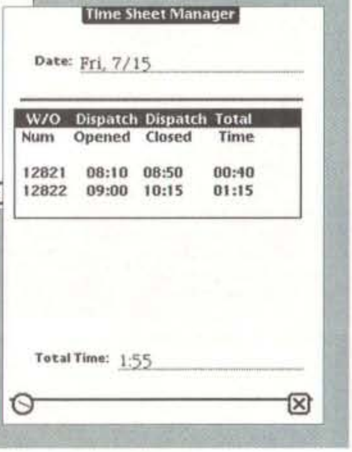
Enter summary

Vicious dog at repair site. Unable to repair. Will return with steak.

The Work Order Manager lets craft technicians receive dispatches from the service office, enter comments, and close out the job ticket. ►



The Direct Access Test Unit screen is the heart of the CDA's automated test capability. Instead of having to punch the keys of a butt set, the craft technician merely selects tasks from this graphical screen, and the CDA performs the correct test sequence. ◄



Date: Fri. 7/15

W/O Num	Dispatch Opened	Dispatch Closed	Total Time
12821	08:10	08:50	00:40
12822	09:00	10:15	01:15

Total Time: 1:55

The Presentation Manager keeps track of every time the craft technician opens and closes a job; from this information, the CDA automatically builds a time sheet that can be uploaded to legacy accounting systems. ►

Coming to Market

The Dracon SuperTech 2000 CDA is still in development, with the first customer shipments planned for sometime between March and May. Schillaci expected to begin beta-testing software in November 1994 and estimates the final code size will be about 500 KB. Dracon is currently working closely with Bell South, GTE, and Pacific Bell on its CDA, he adds, and is also talking with Bell Atlantic, Nynex, and other independent telephone companies.

Pricing hadn't been set by the time this went to press, but Schillaci says the cost will be value-added, meaning it will reflect the base $800 price of the Newton incremented by the value of Dracon's numerous enhancements and software capabilities. By way of comparison, Schillaci notes that less-functional CATs sell for between $2500 and $5000. "There really aren't any competitors for this [CDA] now," he adds.

The precise manufacturing details also were not firm at press time. The most likely scenario is that Apple will manufacture the CDA under contract to Dracon, using excess plant capacity in Taiwan and Japan, and Dracon will handle the final testing, configuration, and delivery out of its Camarillo, California, facility.

This relationship between Dracon and Apple, Schillaci claims, offers each party the best of both worlds. "Our expertise is ruggedized products—[preventing] what the environment, sunlight, and so on can do to products," he says. "Apple understood the limits of their design. We're going to ruggedize it, and then they or anybody else can leverage off that."

The selling proposition for the SuperTech 2000 CDA is thus threefold, Schillaci says. "We will save you money today," he says, through increases in efficiency and reduction in costs. He adds that "we will save you money tomorrow" by putting in a distributed, TCP/IP-based network infrastructure and reducing the difficulty of migrating your back-end OSS systems. And "we will even make you incremental revenue," he notes, because support for digital ink and signature capture on the CDA will enable the repair people in the field to sell services to customers and take orders from them right on the device's screen.

The only caveat is offered by the Gartner Goup's Dulaney, formerly a manager at Grid Systems, who has traveled down this road before. "The phone companies will want supplies of these devices for five years," he warns. "But doing special orders is not Apple's paradigm. That's what killed us at Grid." ■

Andy Reinhardt is BYTE's West Coast bureau chief. You can reach him on the Internet or BIX at areinhardt@bix.com.

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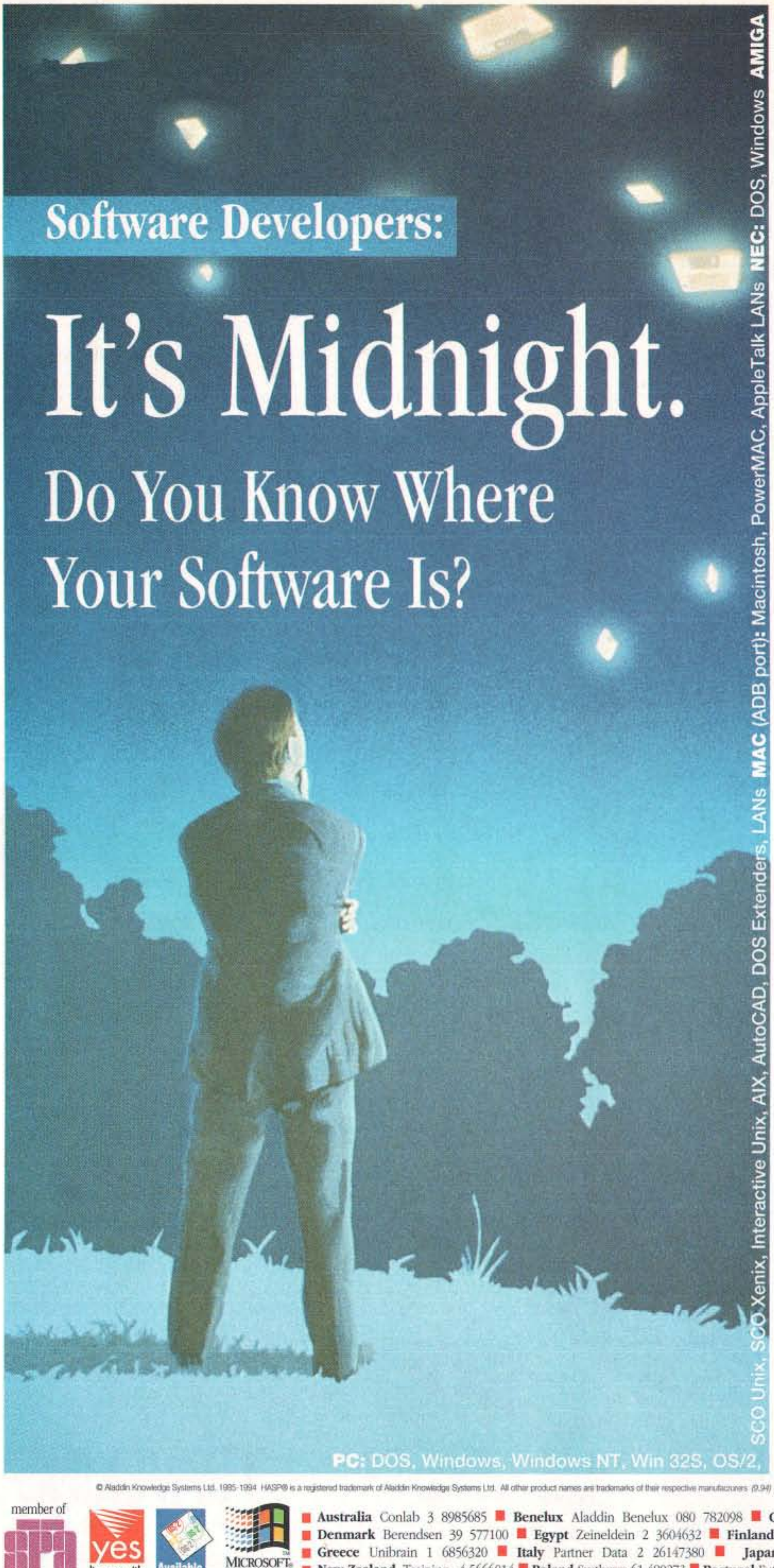

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Mosaic: Beyond Net Surfing

LESLIE COBER-GENTRY © 1995

JOHN R. VACCA

It's easy to get tangled up in the Internet: Finding information can take too long. Servers might be down. Connections mysteriously croak. You have to know which vendors and collections to search, as well as the specific query language for the system. You have to be careful while formulating your query. You sometimes have to look through too many hits, which are not sorted in order of relevance. You are working under pressure while paying for connection time. And it's hard to avoid distractions—scrolling through the Simpsons newsgroup instead of tracking down those files on new object management technologies, for instance.

Nevertheless, the Internet provides access to a worldwide collection of information resources and services. But for a new user, it can be confusing. Navigating the network can be an exercise in frustration for even the most ambitious networker.

Fortunately, software is available that can help. Many users are turning to the Mosaic program—some estimate its usage at 1 million. This browsing software gives you a graphical interface for navigating the Internet. It's probably the most popular means of wending through the WWW (World Wide Web)—that hyperlinked cornucopia of information resources. But Mosaic is more than an easy-to-learn GUI for net surfing. It can also be a tool for publishing information on the WWW.

Mosaic is more than a GUI for navigating the Internet; it's also a tool for doing business on the World Wide Web

Mosaic was developed at the National Center for Supercomputing Applications, at the University of Illinois at Urbana-Champaign, as an Internet-based, global, hypermedia browser. It allows you to hunt for, retrieve, and display documents and data from all over the Internet. It's a window on the ever-expanding world of on-line information.

As a hypermedia browser designed for searching and retrieving, Mosaic provides a unified interface to the diverse protocols, data formats, and information archives used on the Internet. Mosaic draws these disparate pieces into a seamless picture that you can view with relative ease. Once you've located a publisher's home page—the screen of the National Institute of Standards and Technology's home page (on page 78) is a good example—you just click on a table-of-contents-like listing to jump to the information you want.

With Mosaic's hypermedia-based interface, hyperlinks are embedded in richly formatted documents that can include color images and sounds. "Mosaic provides the mechanisms for linking text, sound, images, and animations," says Leslie Southern of Ohio Supercomputer Center User Services (Columbus, OH). "Our server links to other servers with common interests. While some servers are implemented in an outline format, we have gone to great lengths to integrate the information in our server."

At the Ohio Supercomputer Center, for example, the system is set up so you can browse through information on the center's computing facilities. Calendar items, center initiatives, and news releases are closely interconnected, so users can retrieve associated information from any direction. Links are also used to correspond to the level of detail provided.

Furthermore, the interface allows all information located around the world to be interconnected in an environment that permits users to travel through the information by clicking on hyperlinks. "You can move around within complex documents, as well as from document to document across the network, simply by clicking on these hyperlinks," explains Frank Baker, a member of The National Center for Supercomputing Applications' Mosaic development team. You use the same interface for both navigation and document viewing; you can even retrieve information from Gopher, a versatile menu-driven information system, or from WAIS (Wide Area Information Service) or anonymous FTP (file transfer protocol) servers without moving to a different application for each one, Baker adds. Mosaic lets you use a consistent, graphical interface with these hard-to-use Internet tools.

The Mosaic interface is based on the idea of hypermedia, where electronic links—known as *hyperlinks*—are embedded in richly formatted documents that can include full-color images and sound. These documents are presented to users as pages in an interactive, scrollable, online book (see the screen of the Jet Propulsion Laboratory document on page 78 for an example).

You can take advantage of the full-text and index-based search tools provided by WAIS to locate a particular document. As development continues, the system's flexible design allows other information and data resources, such as relational databases, to be integrated into the Mosaic environment.

Mosaic and WWW

Mosaic is part of the WWW environment—a system for maintaining distributed hypertext that originated at the European Laboratory for Particle Physics (known as CERN) in Geneva. Initially developed to keep track of researchers' information and to provide scientists with an easy method of sharing data, the WWW is growing into one of the world's most widely used environments for information publishing.

To access the information stored in WWW repositories, you must use a client or a browser. "Mosaic is one of the most popular browsers," says Craig Schlenoff, an information technology manager at the National Institute of Standards and

Setting Up a Server

To distribute information via the WWW, you first need to set up an HTTP server. The HTTP protocol is stateless, lightweight, and extremely fast, and it provides capabilities that are not found in earlier protocols, such as FTP.

One of the first steps in setting up a server is getting server software. HTTP server software is available from various WWW sources for Unix, Macintosh, Windows, and VMS systems (see http://info.cern.ch/hypertext/WWW/Daemon/Overview.html for more information on writing servers and gateways in general).

Unix Servers

NCSA httpd. This is available at the URL (universal resource locator) ftp://ftp.ncsa.uiuc.edu/Web/ncsa_httpd.

CERN httpd. CERN's server is available for anonymous FTP from info.cern.ch (the URL is http://info.cern.ch/hypertext/WWW/Daemon/Status.html). It's also available from many other sources; use your local copy of Archie to search for "www" to find a nearby site.

GN Gopher/HTTP server. The GN server is unique in that it can serve WWW and Gopher clients (in their native modes). This is a good server for those migrating from Gopher to WWW, although it does not have the server-side script capabilities of the NCSA and CERN servers. See the URL http://hopf.math.nwu.edu/.

Perl server. This is a server written in the Perl scripting language, called Plexus, for which documentation is available at the URL http://bsdi.com/server/doc/plexus.html.

Macintosh Server

MacHTTP is available at the URL http://www.uth.tmc.edu/mac_info/machttp_info.html.

Windows and NT Servers

HTTPS. A server for Intel- and Alpha-based Windows NT systems. It's available via anonymous FTP from emwac.ed.ac.uk in the directory pub/https (the URL is ftp://emwac.ed.ac.uk/pub/https). Make sure to download the version that's appropriate for your particular processor. You can either read a detailed announcement at the FTP site or use the URL ftp://emwac.ed.ac.uk/pub/https.txt.

NCSA httpd for Windows. This server includes most of the features of the Unix version, including scripts (which generate pages on the fly, based on user input). This server is available by anonymous FTP from ftp.ncsa.uiuc.edu in the Web/ncsa_httpd/contrib directory as the file whtp1 1ab6.zip, or at the URL ftp://ftp.ncsa.uiuc.u/Web/ncsa_httpd/contrib/whtp11ab6.zip.

SerWeb. A simple, effective server for Windows. It's available by anonymous FTP from winftp.cica.indiana.edu (or one of its mirror sites, such as nic.switch.ch), as the file serweb03.zip, in the directory /pub/pc/win3/winsock. There is also a Windows NT version of SerWeb, available by anonymous FTP from emwac.ed.ac.uk as the file /pub/serweb/serweb_i.zip.

WEB4HAM. This server is available via anonymous FTP from ftp.informatik.uni-hamburg.de as the file /pub/net/winsock/web4ham.zip.

OS/2 Server

OS2HTTPD. For information, see the home page for details (the URL is ftp://ftp.netcom.com/pub/kfan/overview.html) or fetch the package by anonymous FTP from ftp.netcom.com in the directory pub/kfan.

DOS Server

KA9Q NOS (nos11c.exe) is an Internet server package for DOS that includes HTTP and Gopher servers. It can be obtained via anonymous FTP from inorganic5.chem.uf1.edu or biochemistry.cwru.edu.

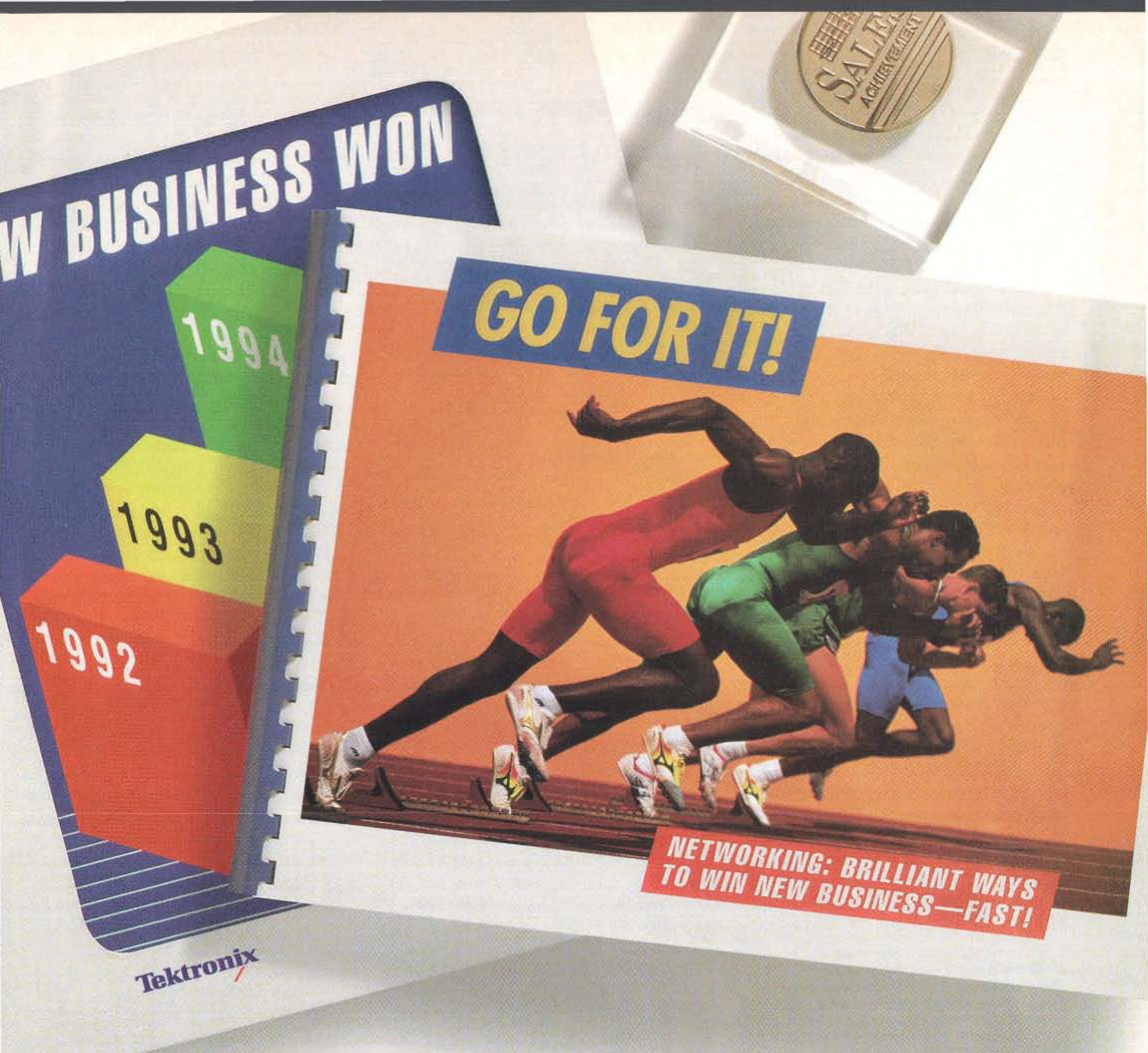
VMS Servers

CERN HTTP for VMS. This is a port of the CERN server. It's available at the URL http://delonline.cern.ch/disk$user/duns/doc/vms/distribution.html.

Region 6 Threaded HTTP Server. A native VMS server that uses DECthreads. This offers a performance advantage, because VMS has a high overhead for each process, which is a problem for the frequently forking NCSA and CERN servers that began life under Unix. A multithreaded server avoids this overhead. It's available at the URL http://keg11.eng.ohio-state.edu/www/doc/serverinfo.html.

Amiga Server

NCSA's Unix server. This Unix server has been ported to the Amiga and is bundled with the AMosaic browser. See the URL http://insti.physics.sunysb.edu/AMosaic/home.html for details.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Technology (Gaithersburg, MD). Because of its hypertext approach, Mosaic makes following references as easy as turning a page, Schlenoff says. "This allows readers to escape from the sequential organization of pages and pursue topics that interest them."

This ease of moving around the Internet is one reason why Sun Microsystems (Mountain View, CA) put its information on a WWW server. "As you know, the World Wide Web is explosive—more than one Web server a day [is] being added onto the net," explains George Paolini, a network manager for Sun. "We see the Web as a way to communicate many things about our company: product information, service information, marketing our viewpoint, and so on. The Web technology allows us, for example, to include URLs [uniform resource locators] in our product ads and gives us a place where people can get more information distributed."

Building on WWW's initial structures, Mosaic uses a client/server model for information distribution. A server sits on a machine at an Internet site and answers queries sent by Mosaic clients, who can be located anywhere on the Internet. To a user, the client looks like any other machine application, except it has immediate access to information located all over the world.

These pieces of distributed information that are sent from servers to clients are known simply as *documents*. These documents, available through Mosaic, describe how to navigate through the WWW. Separate documentation exists for each of the three available Mosaic versions. Information about all three versions is also available on-line through the Mosaic entry page.

Clicking Through History

A Mosaic hyperlink is designated by underlined text, which indicates that a link to another document exists. To view an attached document, you click on the underlined text. Mosaic maintains a history window on every document that you view (see the screen). Clicking on the Back and Forward buttons lets you travel forward and backward through the window's history.

Clicking on the history window itself displays the list of documents you have viewed. Double-clicking on any document title takes you to that document. The first document on the list is the aforementioned *home page*—the document you see when you first enter Mosaic. Clicking on either the Home or Home Document button automatically takes you to this document.

Ohio State University, located in Columbus, uses its home page as an online public faculty/staff directory. "This page contains only text, but it is quite useful for looking up people in the college," says system administrator Kurtis Lindemann. "Within the next couple of months, there will also be a private version of the faculty/staff directory that has pictures, voice annotations, movies, links, and whatever else each faculty member would like his or her home page to look like."

Mosaic as a Commercial Tool

Long viewed as a refuge for academics, researchers, and hackers, the Internet has taken a significant step toward becoming a national electronic marketplace with a new high-speed business-to-business network called CommerceNet. Backed by Silicon Valley companies such as Amdahl, Apple, Intel, National Semiconductor, and Sun, the CommerceNet network has embraced Mosaic to help it achieve its niche in the commercial electronic marketplace.

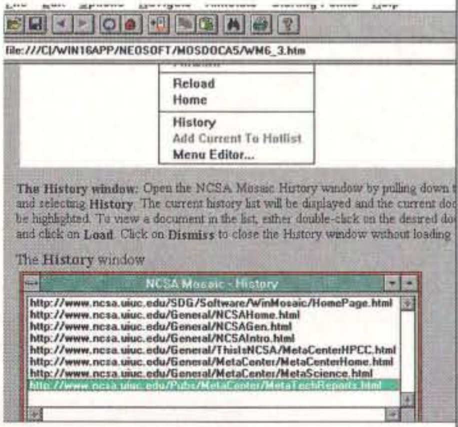
CommerceNet permits Internet-connected companies and individuals to buy and sell goods by using Mosaic as an interface to look up and exchange information, as well as to collaborate on engineering

Coming Attractions

Some of the services that users can expect to appear during the next stages of the commercial Internet evolution include the following:

- Company and service information with graphical impact.
- Listings and personal addresses on the WWW on-line service directory.
- Automated E-mail and fax forwarding that provide immediate response to customer-requested information.
- E-mail list management and distribution.
- File transfer and archive services.
- Multiple hyperlinked pages describing products and services connected to business information and support services.
- Complete Internet connectivity and maintenance services, from simple dial-up to high-bandwidth direct connections.

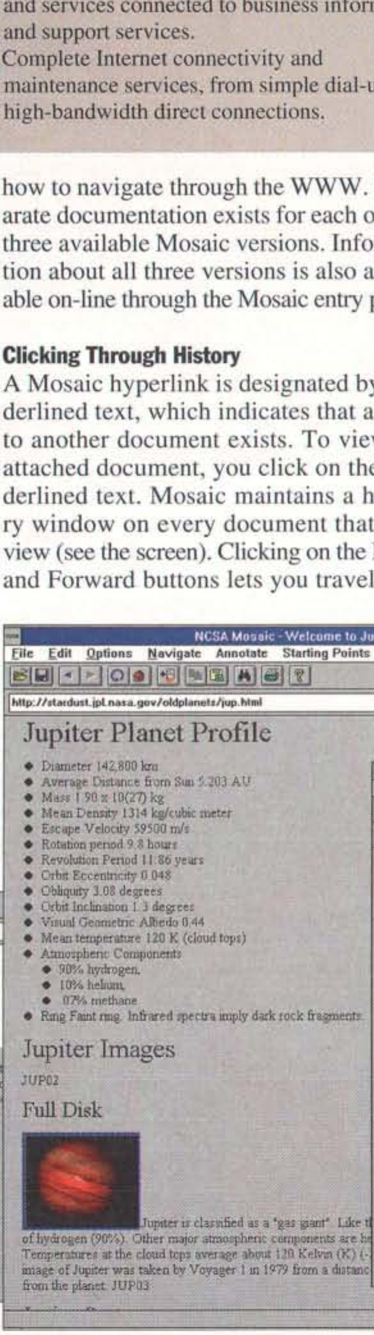
One of Mosaic's nifty navigation tools is the history window (left), which lists the available documents relating to a certain subject. By double-clicking on the name of the file, you can jump to that document and view it. At center is a typical stop on the data highway known as the WWW. This page is from a document about Jupiter, published by the Jet Propulsion Laboratory. At right is the home page of the National Institute of Standards and Technology. By clicking on underlined text, you can jump to the information linked to the corresponding line in the table of contents.



The History window: Open the NCSA Mosaic History window by pulling down t
and selecting **History**. The current history list will be displayed and the current do
be highlighted. To view a document in the list, either double-click on the desired do
and click on **Load**. Click on **Dismiss** to close the History window without loading

The **History** window

http://www.ncsa.uiuc.edu/SDG/Software/WinMosaic/HomePage.html
http://www.ncsa.uiuc.edu/General/NCSAHome.html
http://www.ncsa.uiuc.edu/General/NCSAGen.html
http://www.ncsa.uiuc.edu/General/NCSAIntro.html
http://www.ncsa.uiuc.edu/General/ThisIsNCSA/MetaCenterHPCC.html
http://www.ncsa.uiuc.edu/General/MetaCenter/MetaCenterHome.html
http://www.ncsa.uiuc.edu/General/MetaCenter/MetaScience.html
http://www.ncsa.uiuc.edu/Pubs/MetaCenter/MetaTechReports.html


NCSA Mosaic - Welcome to Jupiter
File Edit Options Navigate Annotate Starting Points Help
http://stardust.jpl.nasa.gov/oldplanets/jup.html

Jupiter Planet Profile

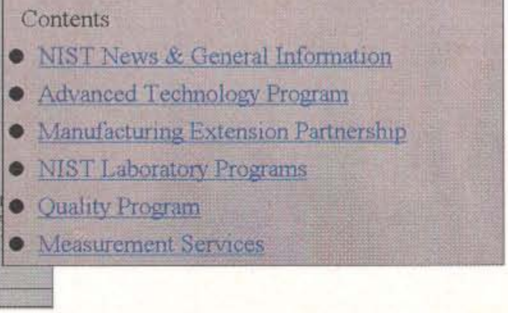
- Diameter 142,800 km
- Average Distance from Sun 5.203 AU
- Mass 1.90 x 10(27) kg
- Mean Density 1314 kg/cubic meter
- Escape Velocity 59500 m/s
- Rotation period 9.8 hours
- Revolution Period 11.86 years
- Orbit Eccentricity 0.048
- Obliquity 3.08 degrees
- Orbit Inclination 1.3 degrees
- Visual Geometric Albedo 0.44
- Mean temperature 120 K (cloud tops)
- Atmospheric Components
  - 90% hydrogen,
  - 10% helium,
  - .07% methane
- Ring Faint ring. Infrared spectra imply dark rock fragments.

Jupiter Images

JUP02

Full Disk

Jupiter is classified as a "gas giant". Like t
of hydrogen (90%). Other major atmospheric components are he
Temperatures at the cloud tops average about 120 Kelvin (K) (-
image of Jupiter was taken by Voyager 1 in 1979 from a distanc
from the planet. JUP03


NCSA Mosaic - NIST WWW - Home Page
File Edit Options Navigate Annotate Starting Points Help
http://www.nist.gov/welcome.html

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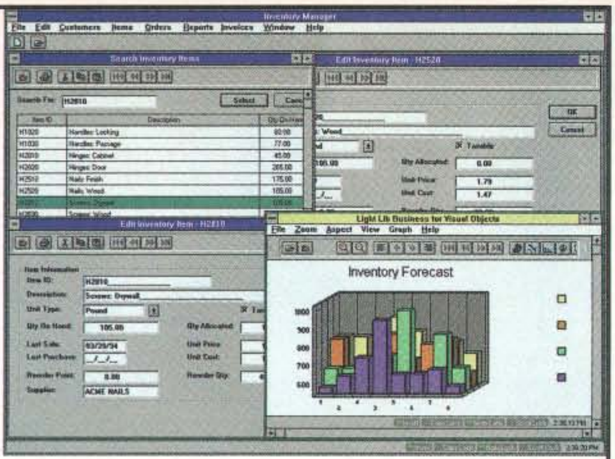
Inventory Manager
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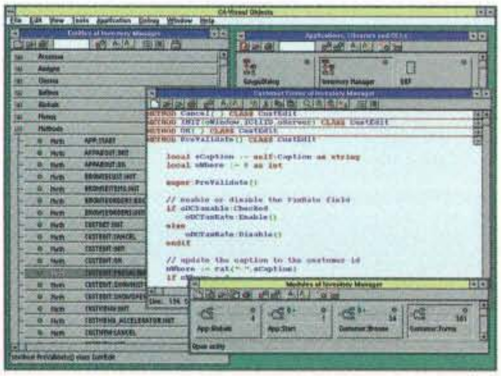

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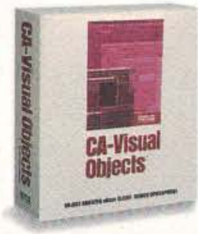

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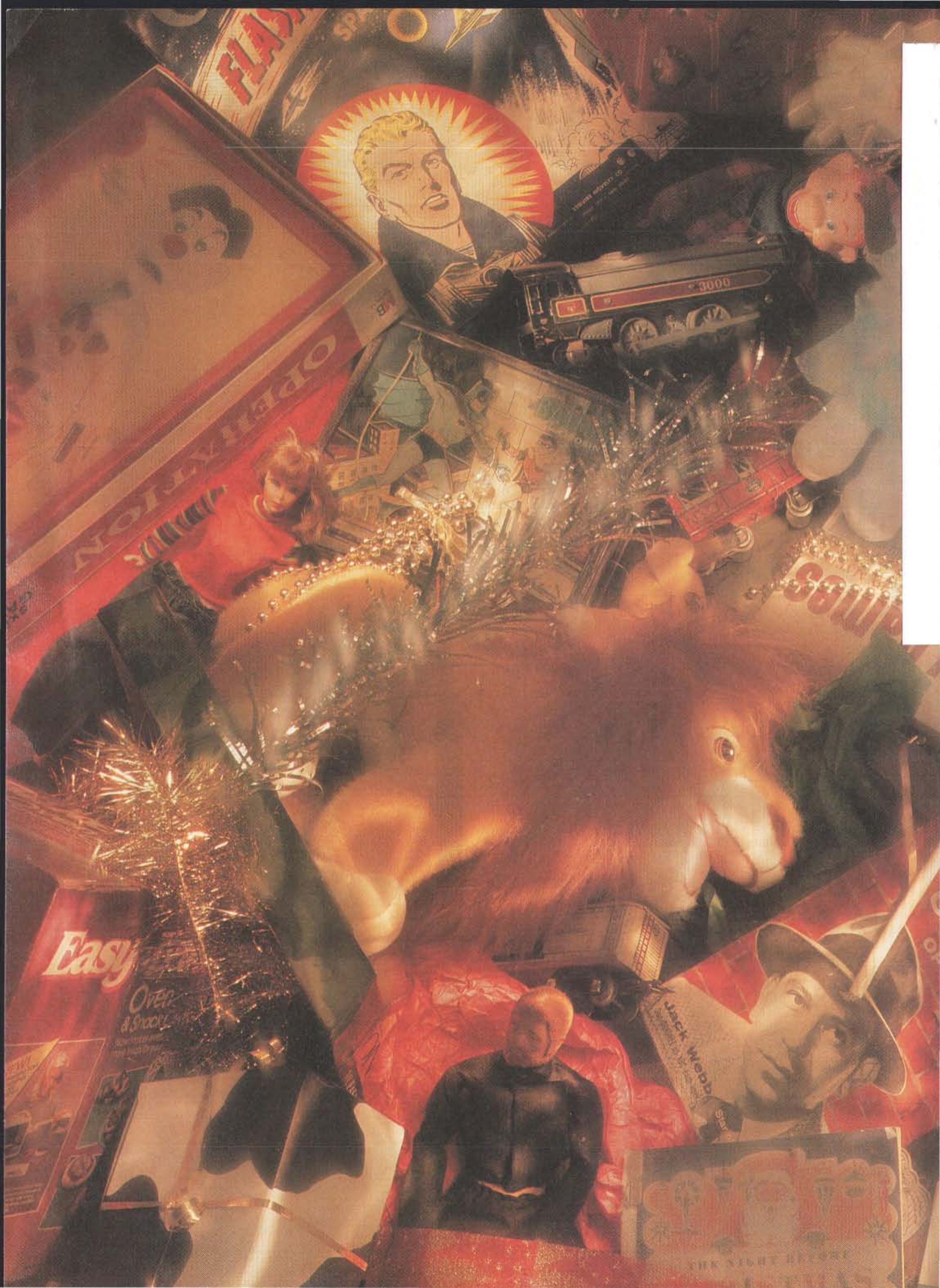
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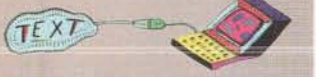

Once you've used NCSA Mosaic for a while, you may want to create your own documents or home pages and make them available to the WWW. If you're familiar with a markup language, such as Tex, Latex, or troff, you'll make the transition to HTML (Hypertext Markup Language) readily.

You can write an HTML document with any text editor. Try the Source button of your browser (or save it as an HTML file) to look at the HTML for a page you find particularly interesting. The odds are that writing an HTML document will be a great deal simpler than you'd expect. If you're used to marking up text in any way, HTML should be intuitive.

A beginner's guide to HTML is available at the URL (universal resource locator) http:/www.ncsa.uiuc.edu/General/Internet/WWW/HTMLPrimer.html. You can also find a plain-text version (at the URL ftp://ftp.ncsa.uiuc.edu/ncsapubs/WWW/HTMLPrimer.txt) and a compressed PostScript version (at the URL ftp://ftp.ncsa.uiuc.edu/ncsapubs/WWW/HTMLPrimer.ps.Z). Because the latter two are FTP URLs, you can fetch them by hand using FTP if you do not yet have a WWW browser.

In addition, there is a good set of HTML documentation available at the URL http://www.ucc.ie/info/net/htm1doc.html, and there's an HTML primer with a URL of http://www.vuw.ac.nz/who/Nathan.Torkington/ideas/www-html.html.

Again, to learn the particulars, see the relevant on-line documentation.

and other projects. Backed by $24 million in federal government and industry financing, it is one of the first significant efforts to bolster the Internet by providing more robust software with the security features needed for electronic commercial transactions. "Buyers and sellers can now meet on the network and trust each other," says Jay Tenenbaum, chairman and founder of Enterprise Integration Technologies (Palo Alto, CA), one of the developers of CommerceNet.

One company currently demonstrating its wares in this new electronic shopping center is the Internet Shopping Network, based in Menlo Park, California. Referring to itself as the "toy store of the global village," the Internet Shopping Network is competing with the giant computer superstore chains by connecting buyers directly to distributors via a Mosaic interface.

Open to anyone on the Internet, CommerceNet takes advantage of Mosaic's ability to act as an information-retrieval and browsing system. And CommerceNet developers are adding both data-coding and digital-signature technology to Mosaic's capabilities. "That will make it possible for users to conduct business transactions without fear of fraud or theft," Tenenbaum claims.

CommerceNet's coding technology is made possible by an agreement between CommerceNet and RSA Data Security (Redwood City, CA). This agreement will make it possible to develop and distribute secure versions of Mosaic that will communicate with special information-server computers.

Authoring Systems

In today's information systems, there are "islands of information" from which it is difficult to access anyone else's data in a uniform manner. For example, you must use the Dow Jones interface to search Dow Jones for a financial analyst report, and you need the Dialog interface to search a database there. Even within a single vendor's informaton repository, the tools are difficult to use.

Users want one easy-to-use program to provide uniform access to all data, whether it's from private, corporate, or commercial sources. And information providers need tools for setting up their data repositories. This is what authoring systems with a Mosaic interface are all about. Two such systems, from InfoSeek and Quarterdeck,

The Global Schoolhouse Project

The GSH (Global Schoolhouse) Project connects classrooms around the world to demonstrate the use of the Internet and Mosaic in the K-through-12 school environment. The project is developing collaboration technologies, interfaces, and advanced information-retrieval tools.

The main objectives of the GSH include the following:

- Demonstrate how people and information resources on the Internet can be used as a classroom tool for research and as a medium for interactive, collaborative learning with Mosaic.
- Teach students how to become active learners and information managers.
- Develop an ongoing, on-line system of training and support for teachers so that they can use Internet technology and tools effectively in their classrooms.
- Demonstrate the most current technologies in a classroom setting.
- Encourage business, government, school, higher-education, and community partnerships for ongoing collaboration concerning the integration of technology into the classroom.

The GSH Project is sponsored by the National Science Foundation, with support from AT&T, Cisco, Cornell University, Farallon, SuperMac, U.S. Sprint, the University of Illinois, Zenith Electronics, and other organizations. Curriculum and classroom activities coordination is provided by the Global SchoolNet Foundation (Oceanside, CA).

The GSH Project involves live videoconferencing among the students and teachers using Cornell University's CU-SeeMe software and telephone audio. The project has recently incorporated audio that is transported over the Internet using Mosaic and Maven software, which was developed at the University of Illinois.

Current GSH Project schools in the U.S. are located in California, Illinois, Iowa, Missouri, Nebraska, New York, North Carolina, Tennessee, Utah, Vermont, and Virginia. Participants outside the U.S. are located in Australia, Canada, England, France, Finland, Germany, and New Zealand. Japan, Norway, the Philippines, and several other countries are planning to participate in the future.

In conjunction with the activities in their classrooms, students conduct at least one live videoconference with a government official in their area of study to discuss the results of their research and hold a question-and-answer session. The advantages of such an activity include demonstrating the accessibility of the government to the public via the Internet and promoting early involvement in the processes of government by students.

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are new to the market.

InfoSeek has established a commercial Internet search service that interfaces with Mosaic. It's compatible with existing Internet end-user tools and protocols. It enables Unix, PC, and Macintosh users to use Mosaic as a common user interface and perform an easy point-and-click operation to browse, search, and retrieve information.

By late 1995, in addition to offering the basic Mosaic search service, "we will also be providing our advanced Mosaic search software and Internet server software to anyone who wants to make their information accessible over the Internet for either commercial or noncommercial use," says Steve Kirsch, president and CEO of InfoSeek. "This will expand the network of information sources available to all InfoSeek subscribers. InfoSeek Mosaic CUI (common user interface) software will hide the complexity of where the data is located and which protocols were used to retrieve the information."

FOR MORE INFORMATION

Ellery Systems, Inc.
4840 Pearl East Cir.,
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Boulder, CO 80301
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InfoSeek
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Albuquerque, NM 87185
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fax: (505) 844-8480

InfoSeek says it has applied for patents on two approaches for finding information with Mosaic. One is a method for immediately identifying which information collection(s) are relevant to a user's query, thus saving the user from having to know where to search. The other is a method for combining the results of searches from different collections in a way that properly merges the relevance rankings, regardless of the underlying search-engine technologies. Solving these problems, Kirsch says, is necessary to truly provide total access to global information resources.

Quarterdeck Office Systems plans to bring its commercial version of Mosaic and publishing tools to market in 1995. Company officials say their planned enhancements include faster performance, multimedia viewers, and an improved user interface compared to current versions of Mosaic.

Quarterdeck will target two major market segments. SOHO (small office/home office) and individual users will use the basic package for Internet navigation and document viewing. These users will find it easy to capture information from any Internet node without the expert knowledge of computer commands that's required by other interface options, Quarterdeck officials say. Corporate and Fortune 500 accounts will use the advanced Mosaic tools for development of multisite information systems.

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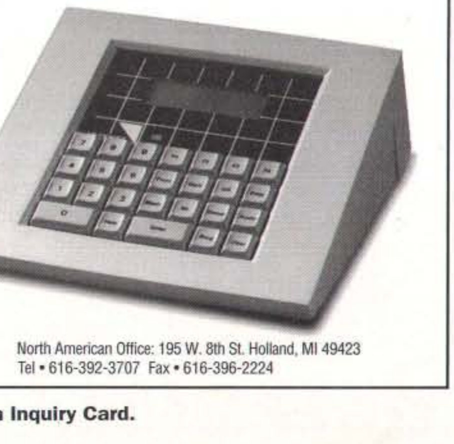

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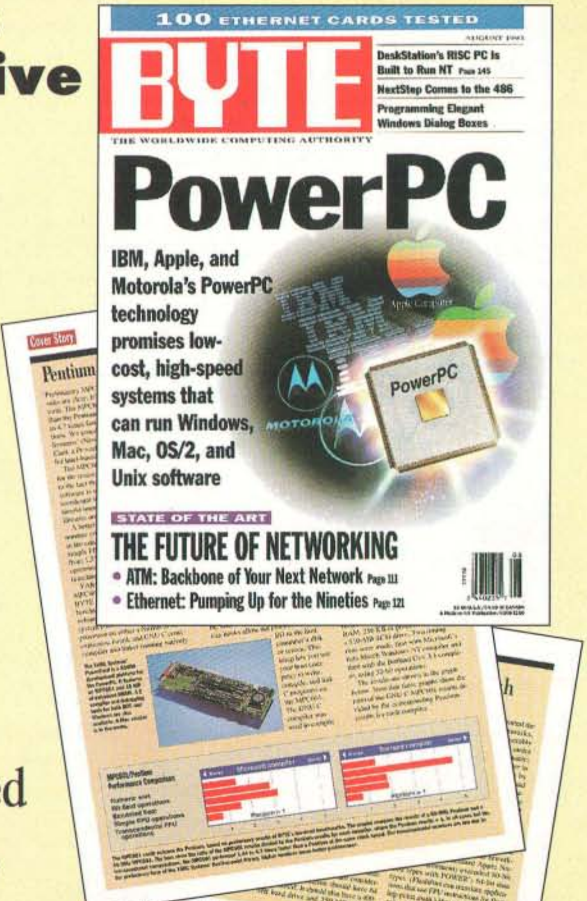
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AUGUST 1993

BYTE

DeskStation's RISC PC Is Built to Run NT Page 145

NextStep Comes to the 486

Programming Elegant Windows Dialog Boxes

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STATE OF THE ART

THE FUTURE OF NETWORKING

- ATM: Backbone of Your Next Network Page 111
- Ethernet: Pumping Up for the Nineties Page 121

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The Magazine of Technology Integration

Ellery Systems provides a Mosaic interface with its Global Commerce Link services, which are focused on providing cost-effective Internet communications services to businesses worldwide—especially SOHO users, independent consultants, and telecommuters. GCL gives users on-line offices that put their small businesses on the global commerce map.

GCL has the potential to advertise a business to millions of customers, seven days a week, 24 hours a day. More important, GCL allows a company with a Mosaic interface to quickly and efficiently serve its customers with automated responses to information requests, automated price-quotation services, globe-spanning E-mail capability, and more.

Being able to use Mosaic to instantly communicate current product information to customers and sale forces around the world can give a company a huge advantage over competing firms. Also, being able to automate same-day responses to customer inquiries and requests for quotes is an enormous advantage over competitors who don't have Mosaic—and who must rely on delivery services that can take days or even weeks to deliver information.

In short, GCL packages the communications power of Mosaic for a business. GCL services start by preparing colorful, graphical information about a business, which is then displayed on the Internet. Automated information, ordering and fulfillment services, customer mailing and list management, electronic-document creation, and document archiving are just a few of the services that GCL offers.

Evolving Mosaic

In the next few years, the commercial Internet evolution—of which Mosaic is a part—will put adventurous businesses on the global information highway. With immediate presence on the WWW, a business will be able to differentiate itself from its competitors by acting as a resource for millions of Internet users located around the world.

For people who have an Internet connection—and a considerable degree of patience—searching through the WWW is the best way to find answers to many questions. I used Mosaic to do much of the research for this article. The pointers I've included should help you on your way around the WWW. ■

John R. Vacca is a freelance writer based in Houston who covers information technology. You can contact him on the Internet at 74044.164@compuserve.com or on BIX c/o "editors."

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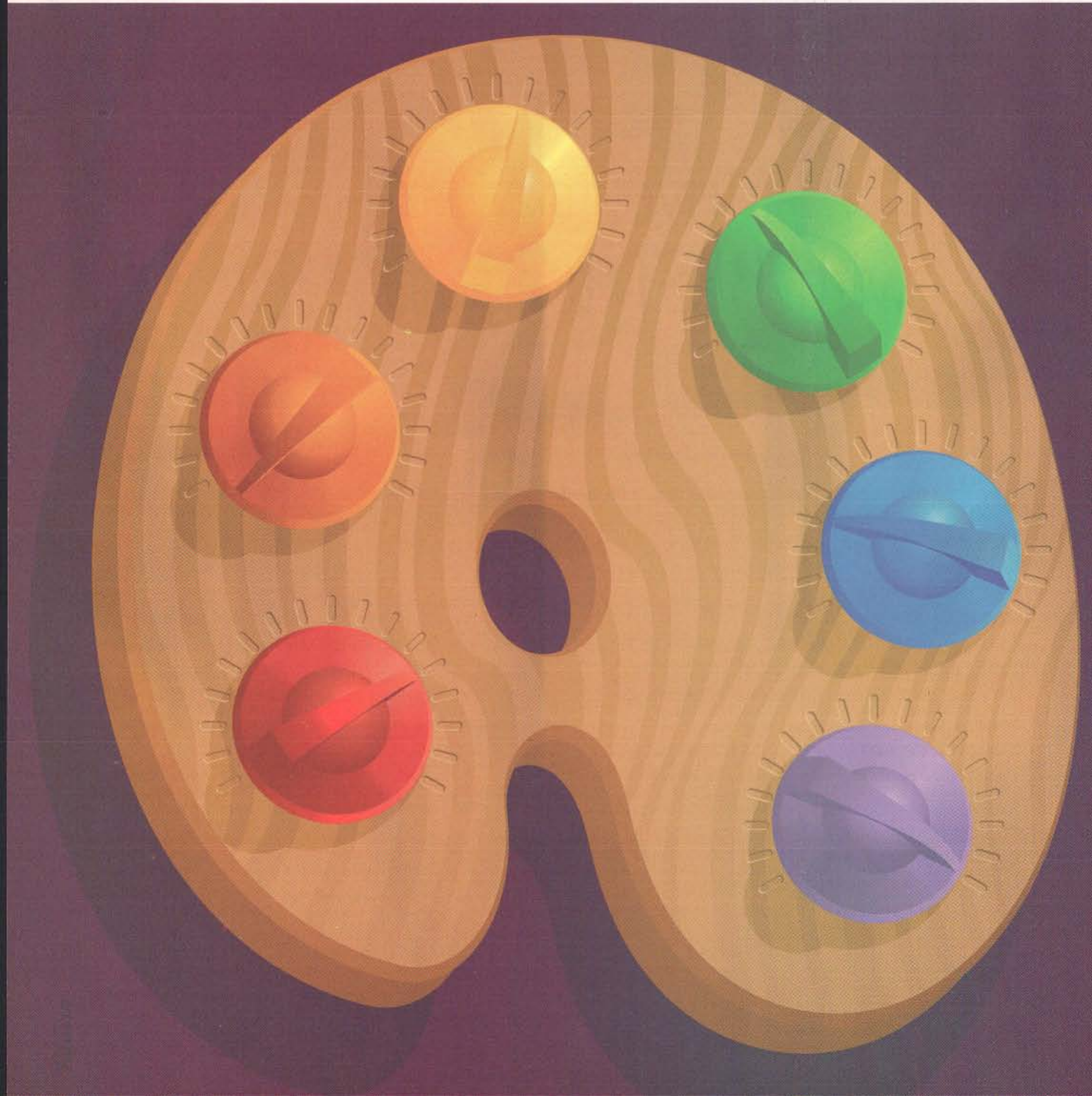
MATCHING COLORS

Making color-printer output match your monitor image is a complex and frustrating problem. But consistent and predictable color management is on the way.



Color is wonderful. It adds impact, interest, and information to most documents and graphics (colorized movies excepted). Color monitors have been available for personal computers almost from the beginning. Today, inexpensive and surprisingly good new printers, using a variety of output technologies, make color printing affordable for almost anyone.

So you fire up your graphics program, whip up a color chart, poster, or image, and send it off to your desktop color printer. Surprise! You discover that the printed color doesn't match the color on your screen. Remember that favorite color photograph of your family that you had put on Photo CD? The monitor image doesn't look like the glossy print, and when you send the image to the printer, the output doesn't look like the original or the image that was on the computer screen.

Color can be a serious problem. Its quality changes from one device to another and from one operation to the next. There is no consistency, no accuracy, and no predictability.

Computers manipulate color images in a number of ways. You can scan a photograph or painting into digital form and then rework it using software, with effects judged on your monitor's screen. Or an artist can create original art directly on his or her computer, without any physical object. From there, the artwork can be translated into a number of different file formats, combined with other images and text, proofed on a variety of color or black-and-white devices, shown on a projection panel, printed out on high- or low-quality paper, sent on for full-color reproduction via offset or gravure printing, or incorporated into a multimedia product that is designed to be viewed on someone else's computer.

What is merely a frustrating annoyance for one user can be a crippling and expensive problem for the user who must maintain consistent color across a variety of applications, displays, and output devices. You can't have the company logo appearing in 15 different shades of red, ranging from orange to purple. And, if you're showing off a product, your reproduction had better look like the real thing.

The problem is real. The good news is that help is on the way. A variety of products tackle this problem head-on, and some of these technologies are being integrated into the next generation of operating systems, such as Windows 95 and SunSoft's Solaris.

Standards and Software

In "Consistent Color," Michael Sugihara discusses the roots of the color-matching problem, beginning with the ways in which we define color. He describes the fundamental differences between the color of transmitted light (e.g., from your monitor) and that of reflected light (e.g., anything reflected off of paper). He introduces some of the intricacies of color space models, looks at the issues of color calibration and characterization, and explains the difficulties inherent in translating a specific color from one system or model to another.

The bulk of Sugihara's article, however, is concerned with the solutions, not the problems. An industrywide consortium is busy hammering out standards that hold out the promise of accurate and predictable color. Sugihara takes a broad look at several of the leading-edge color management products now on the market. He explains where they're coming from, what their strengths and weaknesses are, and how they differ from one another.

In Your Face

While a color graphic is being manipulated on computer, the primary point of reference is how the image looks on the monitor. It's neither practical nor economical to send the file off to the color printer after every minor revision. For the past few years, monitor makers have been trying to address their end of the color-matching problem, and they have evolved some ingenious new approaches.

In "On-Screen Color," Bill Hilliard, who is a color consultant to the VESA (Video Electronics Standards Association) monitor committee, takes a look at where monitor technology is heading with regard to color calibration and management, resolution, convergence, and other factors. He describes the color management solutions that monitor makers are currently offering with the latest crop of digital monitors. He also discusses the relationship between screen resolution and brightness and provides tips on what you should look for in choosing a monitor and a video card. In addition, he examines the question of how many colors you need in your palette.

However, more than the monitor has to be calibrated; its immediate environment plays an important role. Ambient lighting can seriously alter your perception of on-screen color, and magnetic forces from nearby equipment or even the earth itself can distort color if you're not careful. Finally, Hilliard discusses color-matching issues for the flat-panel LCDs used in laptops and assesses how well their color matches up to that of CRT monitors.

In Print

Hard copy—the output from color printers and four-color printing presses—is the end of the line, the make-or-break area in which you—and your customers and your bosses—judge final color production or reproduction. A new generation of color ink-jet and laser printers is raising user expectations, but how realistic are these?

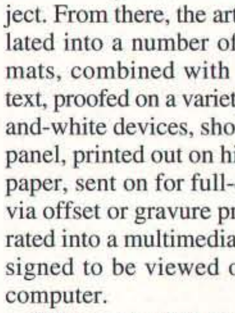
In "Final Output," printer consultant and industry-analyst Michael Weiss examines the current state of the art and the future potential of a number of competing color-printing technologies—ink-jet, laser, thermal-wax, dye-sublimation, and solid ink-jet. He shows how the different technologies compare with respect to speed, consistency, equipment cost, and operating expenses, and he discusses how they are likely to shake out in the marketplace in the next few years. ■

—Russell Kay, Technical Editor

Consistent Color

First, define your colors and standards

..............93



On-Screen Color

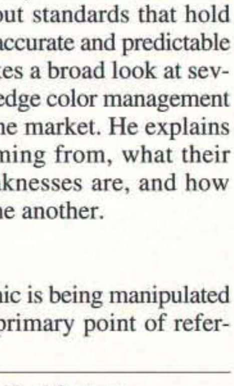
What you see—is it what you want?

............101

Final Output

What you get—how accurate is it?

............109



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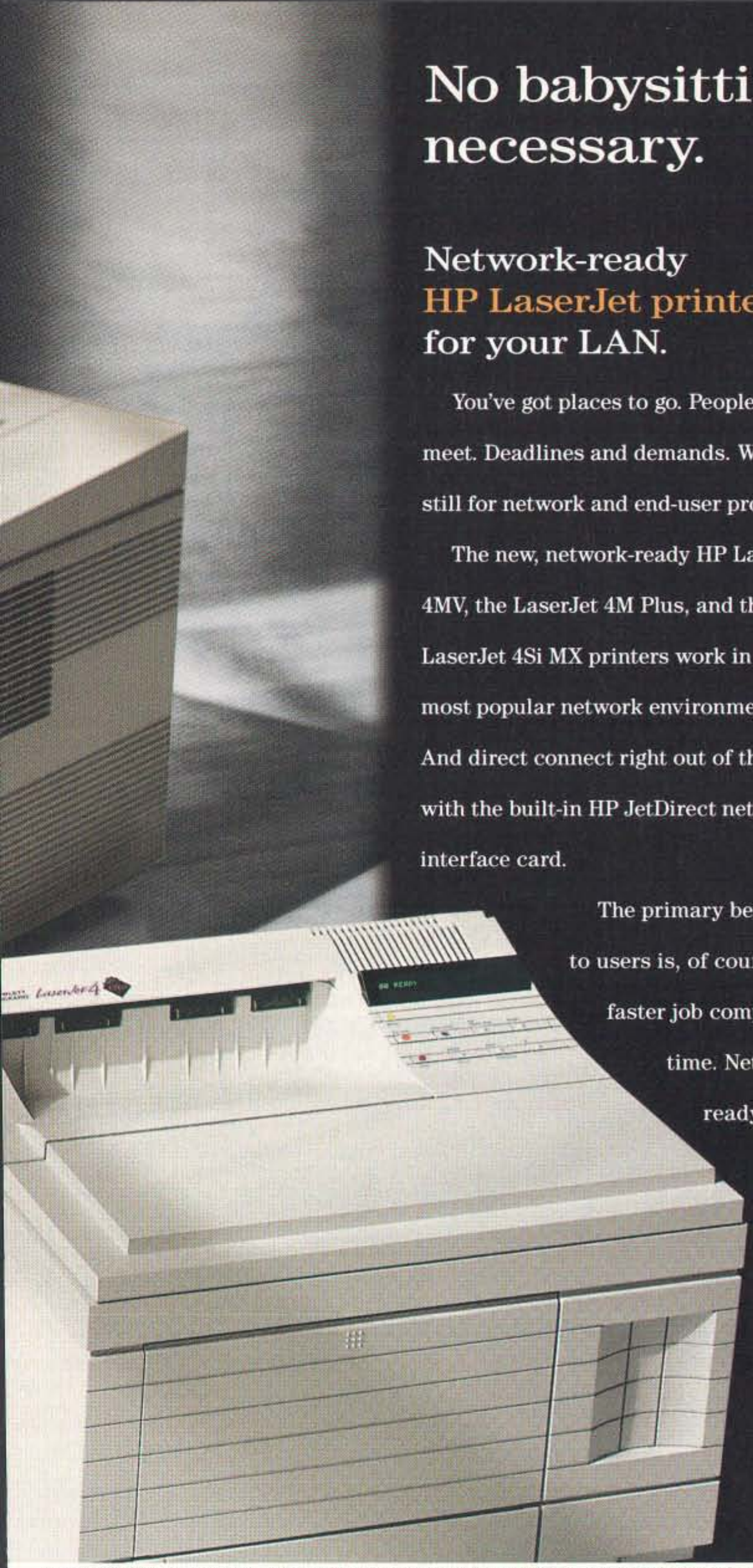
*HP JetAdmin and similar utilities are available for NetWare, UNIX, Mac, LAN Server, LAN Manager and other popular networks. **In Canada, call 1-800-387-3867, Ext. 8549. Adobe, PostScript, and the PostScript logo



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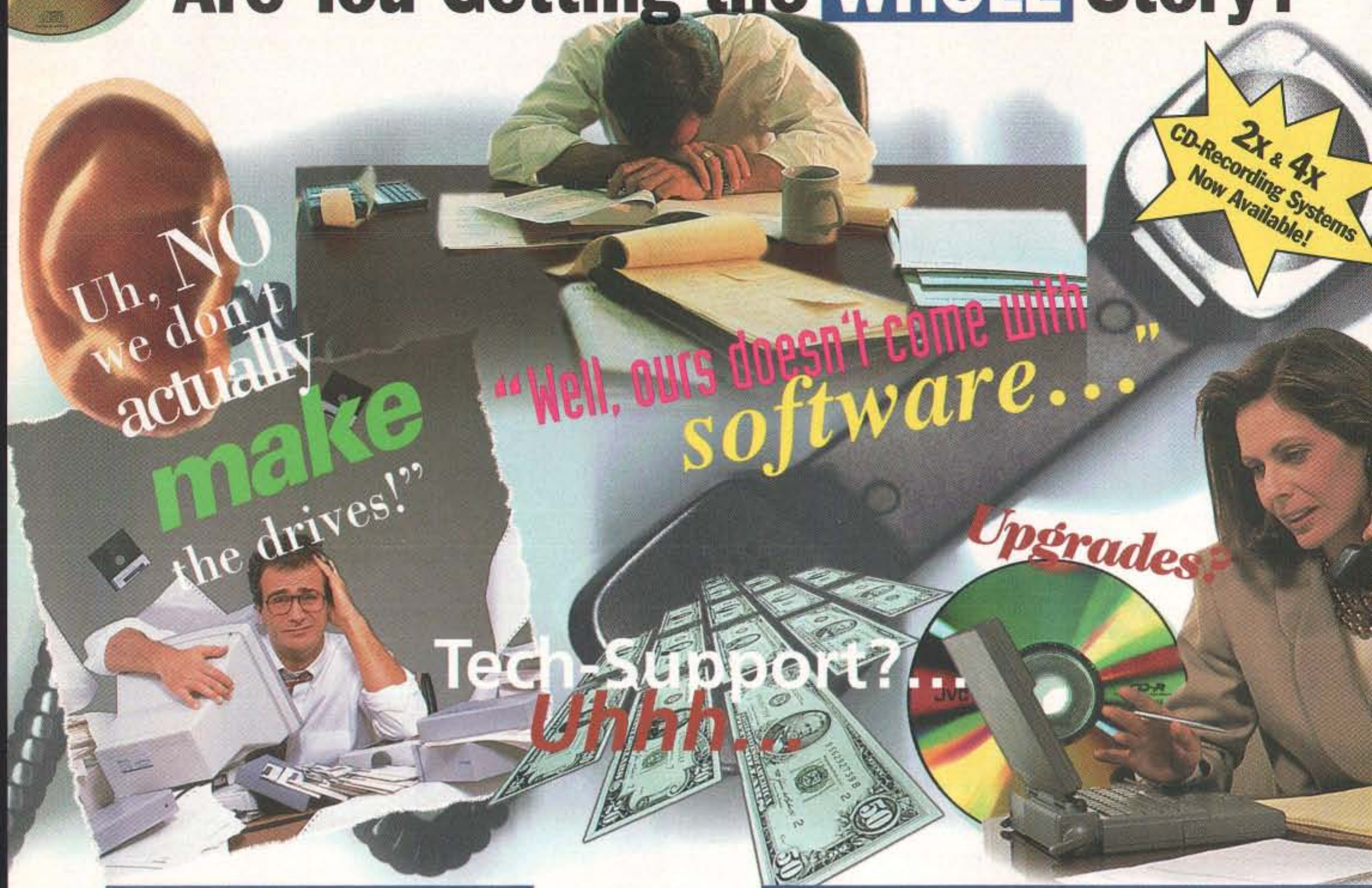
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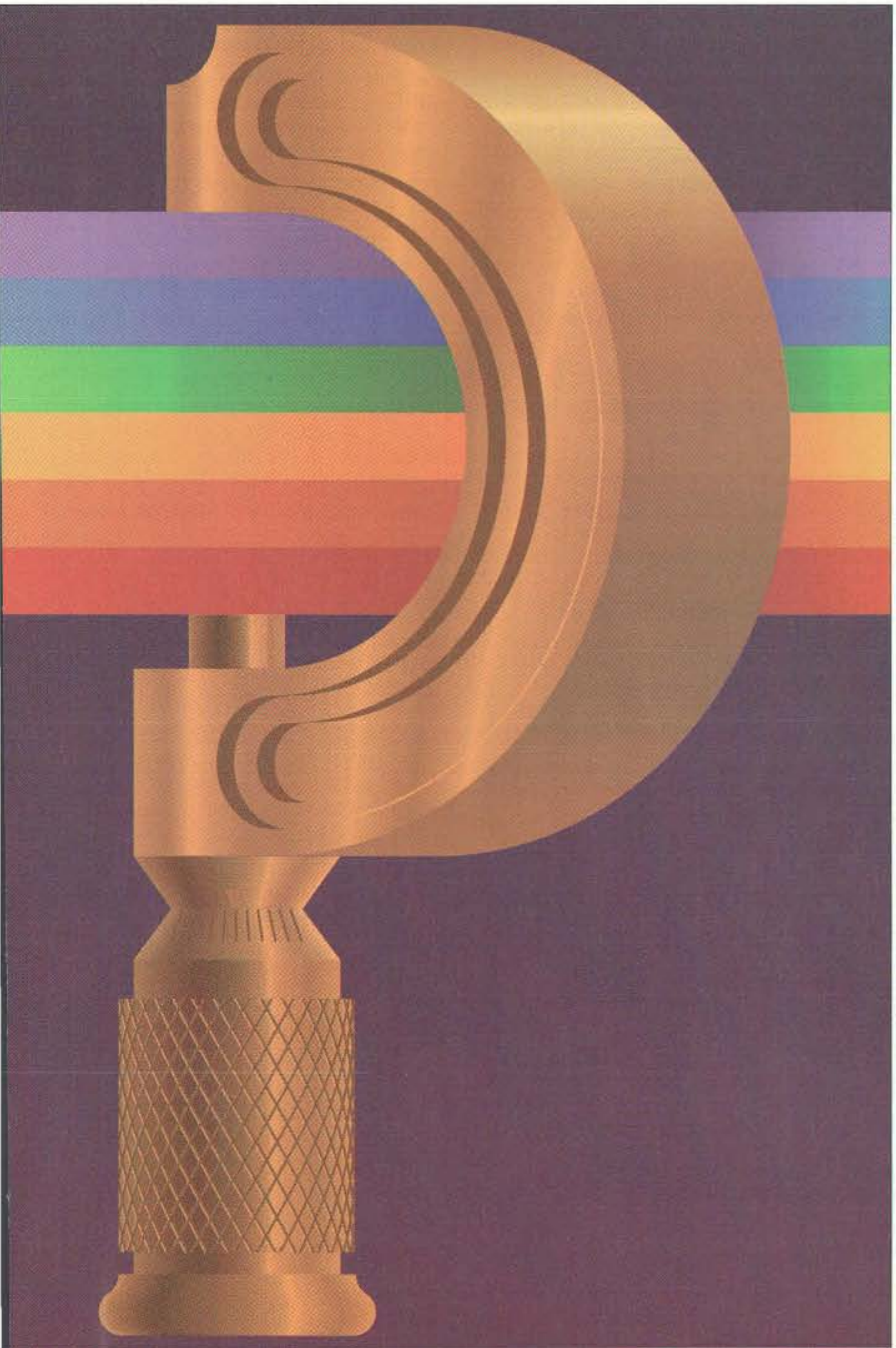
State of the Art

CONSISTENT COLOR

Applications and operating systems that know about color will finally make effective color management available to the mainstream user

MICHAEL SUGIHARA



DANIEL PELAVIN © 1995

Color is more available and less expensive than ever. But the neophyte color user faces a confusing and frustrating situation. After struggling to get a presentation to look just right on the monitor, you are given obscure and unhelpful choices in a printer setup dialog box—"more vivid color," "matches the screen," or "automatic color." After making adjustments to get a desktop ink-jet printer to produce the proper colors, you send the job to the network's high-speed color laser printer for duplication and to a thermal-transfer printer for transparencies. The most expensive surprise of all comes when you send the job to the local print shop for mass duplication on a four-color press. No two of these outputs look quite the same.

If color is to be an effective tool, you must be able to create and enforce consistent, predictable color along the processing chain: scanners, software, monitors, desktop printers, external PostScript output devices, prepress service bureaus, and printing presses. Unfortunately, professional use of color, particularly in the printing and graphics industries, has always been seen as an art, not a science, requiring human intervention throughout the process.

Technology must intervene, and people are still waiting for a good solution. But help is on the way. Many color-matching and color management schemes are coming to market or are already here, including Eastman Kodak's Precision Color Management System, Hewlett-Packard's ColorSmart, Apple's ColorSync, Pantone's ColorDrive, Tektronix's TekColor, EFI's EfiColor, and Agfa-Gevaert's FotoFlow.

Why So Difficult?

The dilemma of color management is that different devices just can't create the same range of colors. Some colors can be easily viewed on a monitor but can't be output accurately on certain printers. Conversely, printing processes can easily produce colors that monitors can't display. Finally, different printing processes have their own limitations.

Color is created on a computer screen in a different fashion than it is on paper. The computer screen emits light directly, but most color that we see in the real world is reflected light. A standard CRT monitor creates color by causing red, green, and blue phosphors (thus, an RGB monitor) to glow. These phosphors on a black mask can simulate a wide range of colors. This system is called *additive color*. (Color monitors are treated in greater depth in "On-Screen Color" on page 101.)

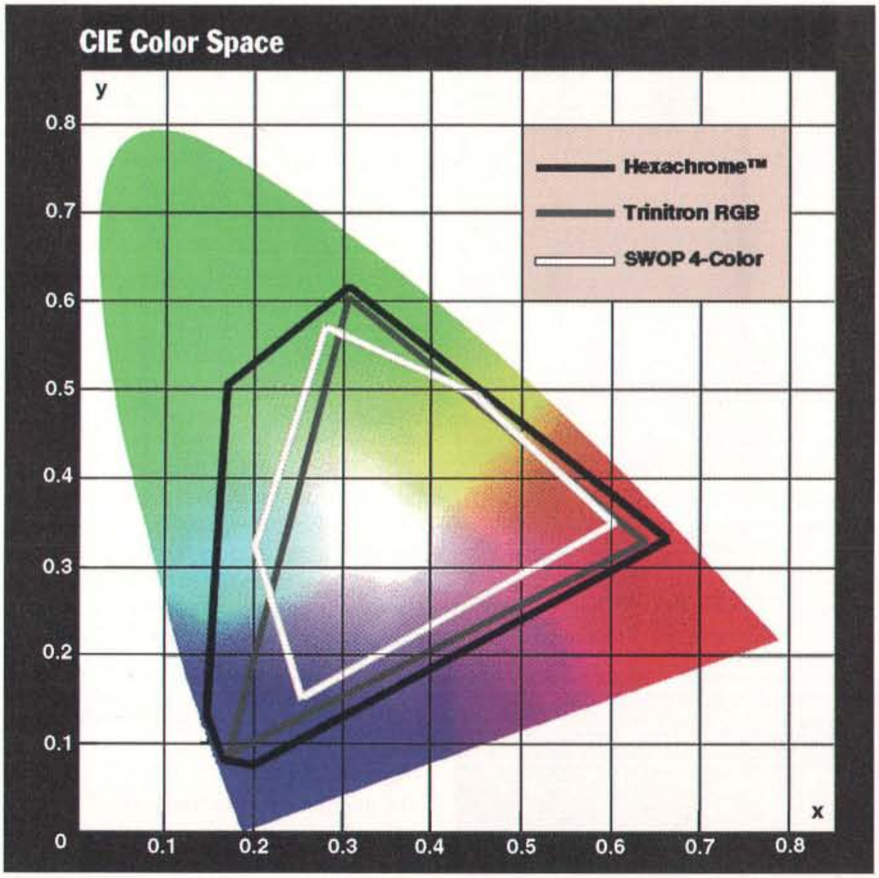
Printed material is created by applying inks or toner to white paper. The pigments in the ink absorb light selectively so that only parts of the spectrum are reflected back to the viewer's eye (hence the term *subtractive color*). The basic printing ink colors are cyan, magenta, and yellow, and a fourth ink, black, is usually added to create purer, deeper shadows and a wider range of shades. This four-color ink process is called CMYK.

Do You See What I See?

The everyday office environment also complicates color management. Ambient light directly affects what you see when viewing a color monitor or hard copy. Sunlight has more blue and green in it than red, and incandescent light has much more red. Fluorescent lamps tend to spike in the green range, and their noncontinuous-spectrum light can further distort colors.

There are also variations among devices, pigments, and media. The phosphors used in CRT displays vary in color and intensity from brand to brand and lot to lot. They change over time. The pigments in inks and toners also vary, and the nature of the pigment can alter its appearance. For example, a fluorescent pigment appears brighter because it absorbs light from outside the visible spectrum and then emits it at a different, visible wavelength. Some types of paper soak up ink-jet ink differently than other types. A paper's whiteness can also vary. Surface characteristics of paper—gloss, texture, and color—change the way people perceive colors.

This perception is perhaps the biggest variable. In general, the eye is more sensitive to yellows and oranges than it is to blues. This sensitivity varies from person to person and usually becomes more exaggerated with age.



The CIE x,y model is a 2-D representation of the full 3-D CIE XYZ color space model. The lines on this figure represent the limits (gamut) of color monitors and of web-offset printing.

Color Spaces

How do you describe color in a meaningful, objective way? Most color systems define color in terms of a 3-D *color space*. The most common systems are RGB for monitors and CMYK for printers. Unfortunately, both these color spaces are device-dependent, because they describe the levels of the signals sent to the device, not the color those signals produce. Send 100 percent red and 100 percent green signals to two different monitors side by side, and you'll see different shades of yellow.

The CIE (Commission Internationale de l'Eclairage) was formed early in this century to develop standards for the specification of light and illumination. From a series of experiments run in the late 1920s, the CIE averaged subjective responses to color patches illuminated by a standard light source and created a series of mathematical transformations. From these, they derived three theoretical primary sources—named X, Y, and Z—that could be combined to produce all colors visible to the human eye. In rough terms, X represents the amount of redness in a color, Y the amount of greenness and lightness (bright-to-dark), and Z the amount of blueness. This system was adopted as the CIE XYZ model, and it's the basis for most other color space models.

It's difficult to illustrate the CIE XYZ model because of its three dimensions. Thus, a 2-D transformation, called the CIE x,y model, was created by separating the achromatic portions (i.e., blacks, whites, and grays) from the chromatic (i.e., those containing hues). A color's position in this space is given by calculating coordinates where the x value is the ratio of the redness value divided by the total reflectance: $x = X/(X+Y+Z)$. The y value is the ratio of the greenness value divided by the total reflectance: $y = Y/(X+Y+Z)$. The resulting color space, or *chromaticity diagram*, is shown in the figure "CIE Color Space."

Translating device-dependent color spaces to an objective color space and back again is the fundamental challenge for color management systems. Some use lookup tables while others use transforms. If the lookup table is too small or the transform method too simplistic, however, rounding errors can lead to color shifts or

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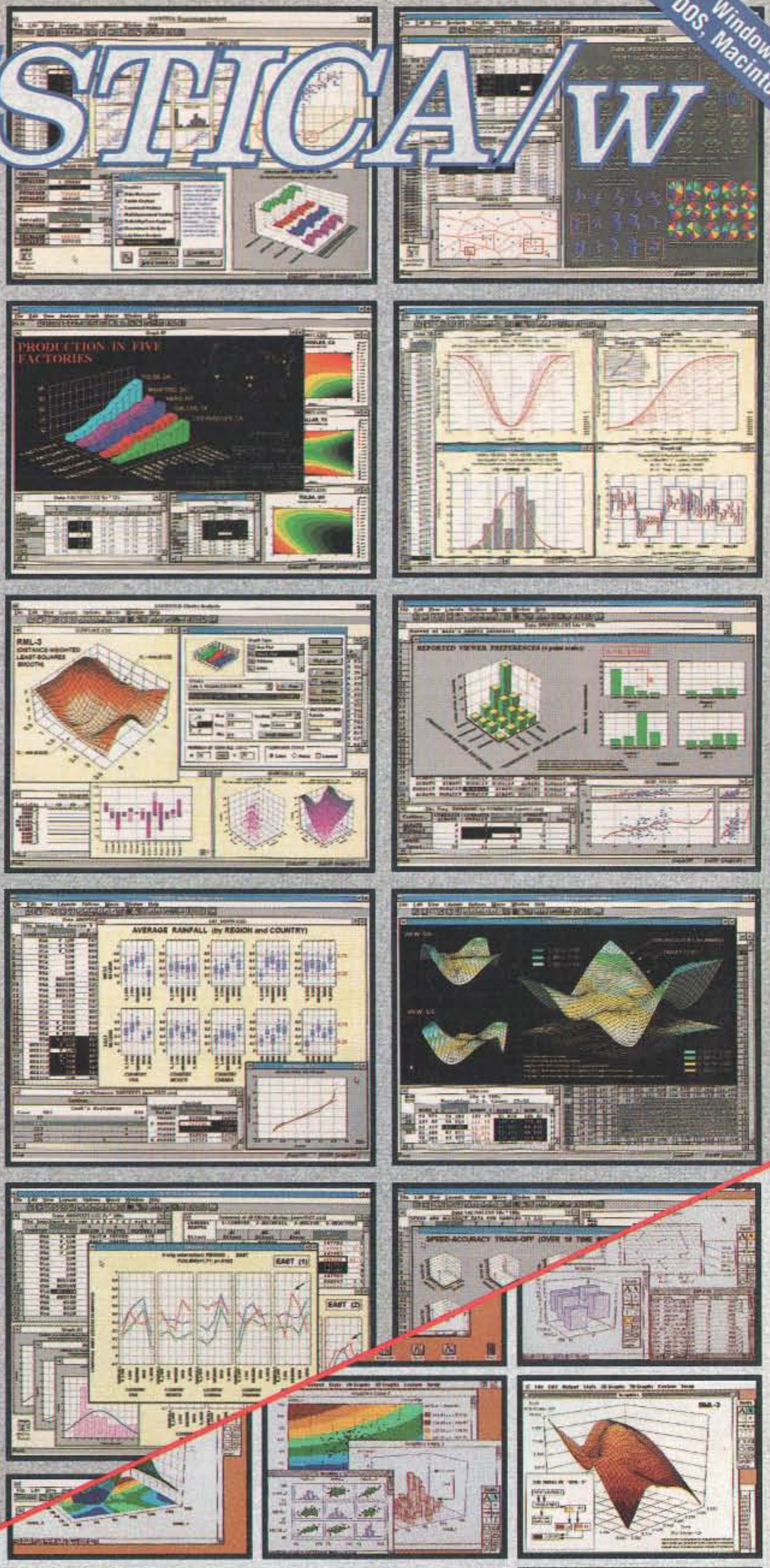
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Lost in Color Space

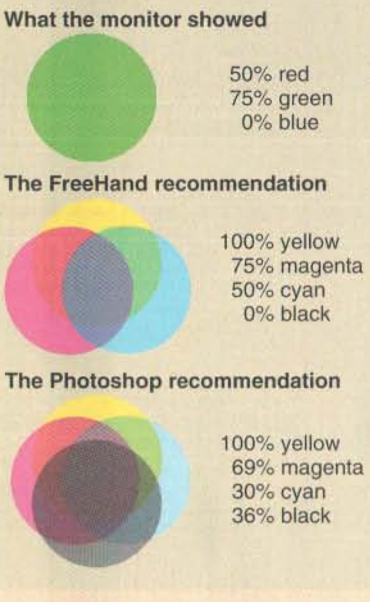
The translation between color spaces can lead to some unexpected results when switching from one application to another. The RGB color space used for monitors and the CMYK color space used for most color printers serves as a good example.

I started with a Macintosh image that, on the monitor, was 50 percent red and 25 percent green. I then used two popular image-manipulating packages, Altsys (formerly Aldus) FreeHand 4.0a and Adobe Photoshop 3.0.

According to FreeHand, to reproduce this image on a CMYK printer requires 50 percent cyan, 75 percent magenta, 100 percent yellow, and 0 percent black. Photoshop, however, calls for 30 percent cyan, 69 percent magenta, 100 percent yellow, and 36 percent black—for the same printer. The figure "Color Inconsistencies" shows what the resulting colors look like.

These differences in translation are not isolated. Products from Adobe, Aldus, and Quark will show variations in color space translations for RGB, CMYK, and other common models. Even comprehensive color systems can run into trouble. Of the original 1012 Pantone colors for coated paper, for example, 70 cannot be properly reproduced with CMYK inks, because they fall outside of the CMYK gamut.

Color Inconsistencies


What the monitor showed

The FreeHand recommendation

The Photoshop recommendation

image degradation. Ultimately, the quality of the output is the only real indicator of a color management system's success.

Color Management Basics

The ideal color management system should enable color control throughout the desktop environment, independent of any individual device's capabilities and limitations. To see how systems accomplish this, consider two fundamental functions: calibration and characterization.

Calibration puts a device into a known state. Variables such as ambient lighting, media characteristics, and pigments must be taken into account, and the viewing environment must be stable. If ambient lighting changes—as sunlight coming through a window—the perception of colors on a monitor will change. For professional work, calibration is mandatory.

Characterization describes the relationship of a device's calibrated state to an RCS (reference color space). The ideal RCS allows both the precise specification of a color and intuitive color selection. Each color management vendor has its own proprietary RCS and characterization methodology. All supply profiles for popular input, display, and output devices. However, devices may require periodic recharacterization to maintain accuracy. For example, monitor phosphors react to temperature and change color with age.

Where Color Management Belongs

Until Apple introduced ColorSync as a part of its System 7.x operating system in 1992, color management was left to specific applications. For example, Adobe Systems' PageMaker 5.0 uses the Kodak Precision CMS, and QuarkXPress 3.2 is bundled with an EfiColor XTension. These high-end systems have produced impressive results, but they are computationally intensive and mutually incompatible (see the text box "Lost in Color Space").

Another approach is to put color selection parameters into the printer driver, as HP has done with its ColorSmart technology. Not a true color management system, ColorSmart tries to anticipate what you expect in color output, with the emphasis on predictability, vibrancy of color, clarity of text, and subjectively appealing colors. Color accuracy per se takes a back seat. This approach is helpful for the casual user, but it works against the overall goal of a WYSIWYG color environment.

Putting color management into the operating system, as opposed to into applications, allows any application to take advantage of color management and will theoretically result in predictable and consistent color. In practice, however, some trade-offs between color management accuracy and system performance still exist.

Standards Please!

Recognizing the problems of cross-platform color, the ICC (International Color Consortium, although originally named the ColorSync Profile Consortium) was formed in March 1994 to establish a common device profile format. The founding companies included Adobe, Agfa, Apple, Kodak, Microsoft, Silicon Graphics, Sun Microsystems, and Taligent.

The ICC published its first standard—version 3 of the ICC Profile Format—in June 1994. Apple plans to integrate the new ICC format into its QuickDraw GX, and SunSoft has committed to using the format in its Solaris operating system. Perhaps most important, Microsoft's promised Windows 95 will also use the ICC format.

The fact that the three most prominent operating environments will support the same device color profiles is important, but it doesn't guarantee that they will work the same. In fact, the ICC Profile Format is designed to be extensible to allow basic color management and to meet high-end prepress production needs. There are also provisions for "private" codes in the format, which some people fear may make certain profiles less flexible and thus complicate cross-platform compatibility.

Windows 95 and ICM

Windows 95 will be the first Microsoft operating environment to include color management, which will be called ICM (Independent Color Matching). This uses a default color-matching module licensed from Kodak, along with device profiles for many common monitors, scanners, and printers. ICM is also expected to be included in a future release of Windows NT.

As of press time, Microsoft hadn't released a Windows 95 beta that included ICM, so the exact implementation and user interface are still unknown. But Microsoft

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and others have discussed many of ICM's technical and architectural elements. According to Myron Kassaraba, Kodak's director of licensing for color management products, Windows 95 will ship with 8^3-size (8 bits describing each of the three color components) device profiles. This is the smallest profile that will produce good results in the desktop environment. ICM's 12-bit transform engine for color matching can also handle more robust profiles (16^3 and 32^3) in professional applications, though at the expense of overall performance. Because ICM will accept the ICC Profile Format, third-party peripheral makers need develop only a single profile for Macintosh, Windows 95, and Unix environments.

ICM's design will reportedly allow you to "plug in" third-party color-matching engines to replace the default Kodak technology. Expect Agfa, EFI, and Pantone to provide such engines during the next 12 months.

Apple's ColorSync 2.0

Although ColorSync has been around since 1992, only a few applications suppliers have used its functionality. ColorSync 1.0 was criticized as not being flexible enough for both casual and professional color users. Also, version 1.0 lacked direct CMYK support, using only the CIE XYZ model for device independence and RGB for QuickDraw compatibility.

ColorSync 2.0 has yet to ship, but it will establish the ICC Profile Format as a practical matter. With this product, Apple will take the industry a long way toward making cross-platform color management a reality. ColorSync 2.0 adds the CMYK color model, so it will support most color printers. It will also support earlier Macintosh technology, including the original QuickDraw and the new QuickDraw GX, and can use version 1.0 profiles and APIs. In ColorSync 2.0, the interaction between applications and color management has been simplified. Third-party color management modules can be used for some devices and the default module for others.

But ColorSync and ICM don't address all your color needs. Both offer basic color management through a device-independent color space model, and device profiles for common displays, scanners, and printers. But neither supplies the tools needed to fully integrate color use into everyday computing. Companies such as EFI, Kodak, Pantone, and Trumatch provide value-added software that will enhance the functionality

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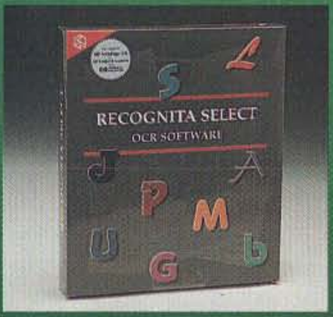

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of the built-in systems. These include tools to match desktop color output to four-color press output and color calibration for individual scanners and monitors.

Pantone's POCE and ColorDrive

In 1963, Pantone (Carlstadt, NJ), a leader in color-reproduction technology, introduced to the printing industry its first color system, PMS (Pantone Matching System). Now it offers many software tools for color management, notably POCE (Pantone Open Color Environment) and ColorDrive.

Announced in October 1993, POCE is the result of a collaboration between Pantone and Light Source Computer Images (Larkspur, CA) to develop a color management system applicable to photographic color and printed spot color. (*Spot color* is a part of an image that is printed with a single-colored ink or toner, not a combination of colors). POCE has since been overshadowed by Microsoft's selection of Kodak technology and by Apple's continuing efforts with ColorSync. As a result, Pantone is concentrating its efforts on its traditional strong point, industry-standard spot colors, according to Andy Hatkoff, Pantone's director of business development.

It can be difficult to take a color created in one application and use it in another. Most solutions are based on standardized palettes created from a fixed number of colors. Unfortunately, these systems don't easily support custom colors. Pantone's ColorDrive, announced last September, is designed to standardize palettes, letting different applications use the same colors and enabling proofing devices (e.g., desktop color printers) to produce output that closely reflects what will be produced via offset or gravure presses. ColorDrive encompasses Pantone's color systems and lets you import and export custom colors between applications. Printer output is calibrated for printers that contain Pantone-licensed palettes and for any printer with ColorSync 1.0–compatible profiles. ColorDrive should be available for the Mac (68K or native Power Mac) this month; a Windows 95 version is scheduled for the second quarter.

Trumatch SwatchPrinter

Trumatch (New York City) created the first process-color matching system specifically designed for digital output. Based on a clever use of the HSB (hue, saturation, brightness) color space, it, too, requires human intervention at the final step of the professional printing cycle. According to Trumatch president Steve Abramson, this is unavoidable, because no current computerized color management tools can yet replace the human eye. The differences between the color capabilities of monitors, color printers, and the four-color press, he says, are still large enough that no amount of manipulating the color space data will result in a "perfect" match.

Color printers—whether ink-jet, thermal-transfer, laser, or dye-sublimation—cannot faithfully reproduce all the colors produced by the inks of a four-color printing press. Trumatch's SwatchPrinter software lets you print a 27-page reference showing the 2000+color Trumatch palette, along with each color's CMYK percentages, on a color PostScript printer. This output can be compared with a Trumatch color swatch fanbook showing the same colors printed on a four-color press, which will pinpoint any differences and simplify color selections for final printing.

Closing in on Consistent Color

Effective color management has come much closer to reality in the past year than many people thought possible. Virtually all major color participants have embraced the new device profile standard, and this year will see color management widely incorporated in operating systems. For the first time, you will begin to see cross-platform compatibility through standardized device profiles and third-party software.

Full color management will still require considerable intervention by trained human eyes and considerable expense. The color professional will find his or her job a little easier because of these improvements. For the rest of us, however, predictable desktop color may, at long last, become a reality this year. ■

Michael Sugihara is vice president of MWA Consulting, Inc., of Palo Alto, California, an industry-analyst organization that focuses on printing and imaging issues. You can contact him on the Internet at mwac@apple .link.apple.com or on BIX c/o "editors."

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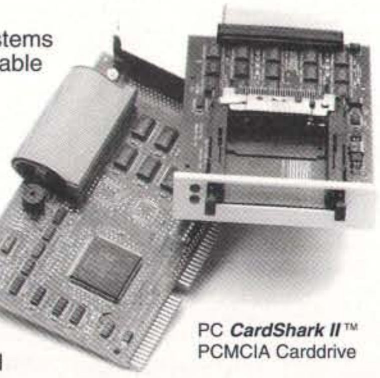

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ON-SCREEN COLOR

There's a lot more to getting and keeping accurate monitor color than meets the eye. New calibration technologies work with color management software to offer unparalleled color matching.

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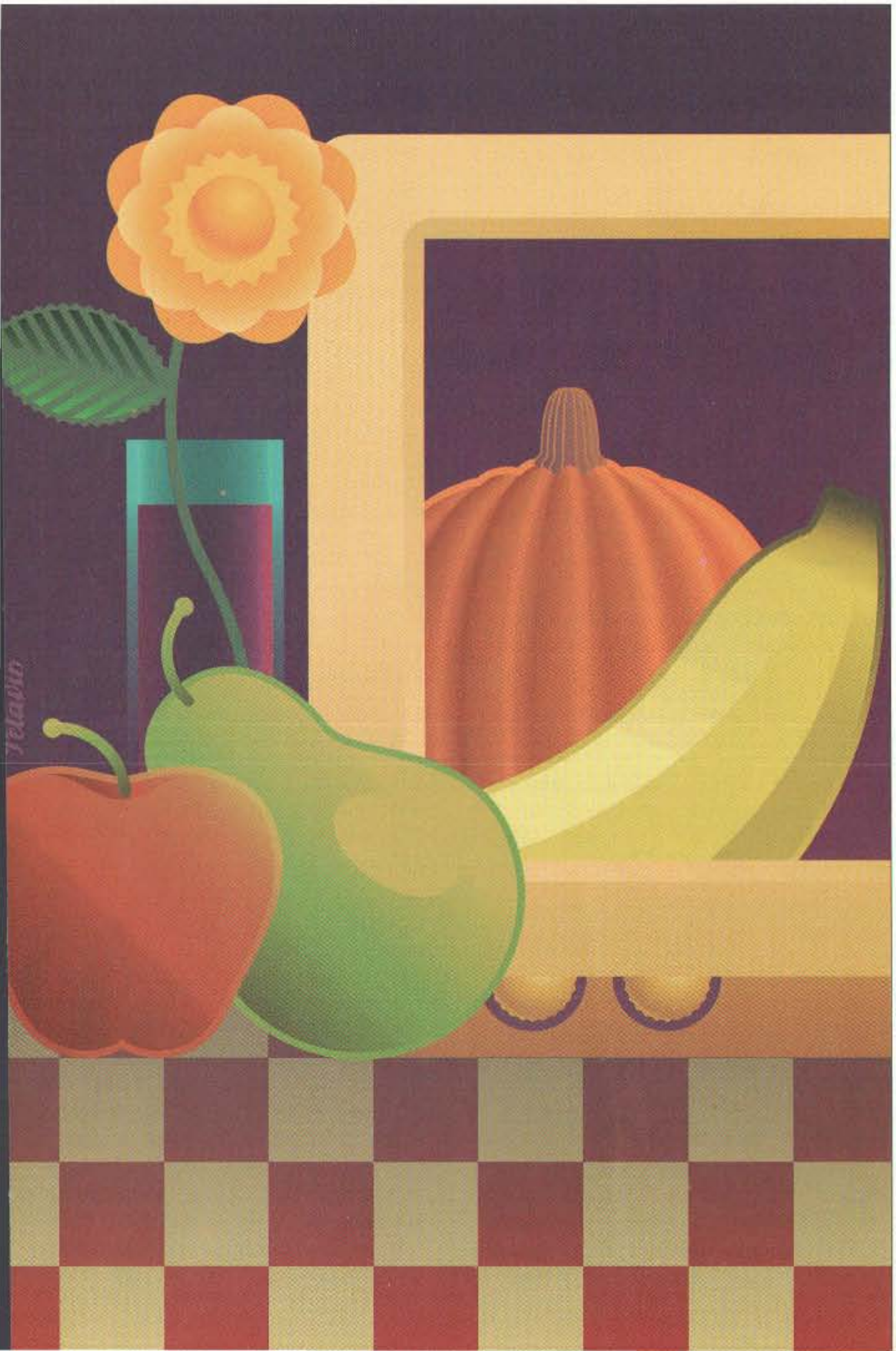

DANIEL PELAVIN © 1995

Color monitors present the illusion that color output is possible. But there's a considerable difference between the color you see on-screen and what you get for output. Although some programs let you pick colors that match Pantone, Trumatch, or other color reference systems, the colors displayed on-screen never match the colors printed. With few exceptions, everyone gets surprised at print time.

For most users, the CRT monitor is the color reference that counts. These users aren't desktop publishing professionals. They don't have color scanners, and they don't try to match reference colors. They're just normal users of office suites, presentations or charting programs, or other applications that display color. For them, the monitor is the device in the computing chain that defines their color palette. They want printed copies or transparencies to match the colors they see on-screen.

What We Want, or What's White?

Besides color the printer can match, users have other expectations. The monitor's overall color balance should be consistent from day to day and from unit to unit of a particular brand and model. This is especially important for work that other computer users will look at. Also, colors should be uniformly pure across the entire monitor, even in the corners.

The monitor should also provide a pleasing look on-screen. Research suggests that North Americans and Europeans prefer a warm "paper white" tone on-screen, while Asians, on average, prefer the cooler, bluish-white tone most monitors default to. Because most monitors are made in Asia, they come with a bluish cast.

What are *cool white* and *warm white*? A monitor's natural color balance is called its white-point color temperature, referring to the color displayed when all three

Picking an Accurate Monitor and Graphics Card

You want or need to buy a new monitor. You probably already know how to tell if one monitor is better than another for general purposes; that information is widely available. But if accurate, consistent color is your most important requirement, what do you really need to look for?

So Many Colors

First, don't buy more colors than you really need. For most desktop publishing applications, the 65,000 colors provided by a 16-bit graphics card are almost indistinguishable from the 16 million of a 24-bit board. Most business and home applications do just fine with a 256-color, 8-bit display. CD-ROM multimedia titles generally use only a 256-color palette, so paying extra for 16- or 24-bit video won't improve what you see on-screen.

Most graphics cards support 24-bit color, 1280- by 1024-pixel resolution, and 72- to 75-Hz vertical refresh rates—but not all three at the same time. This is another reason why most users still run Windows in 256-color mode, especially on large monitors, where flicker is more visible. This won't change until the cost of VRAM drops considerably or there's another design breakthrough.

Palette size isn't really an issue for monitor color fidelity. Multimedia and WYSIWYP (what you see is what you print) color printing works perfectly well for most applications in 256 colors.

However, it is a good idea to look for a monitor that offers some type of color calibration. Many come bundled with software-based color management systems. In addition, you should look for monitors (and video boards) that comply with VESA's DDC (Display Data Channel), preferably DDC level 2, which offers two-way communication between host and monitor. Some monitors skimp by supporting only DDC level 1, which is adequate for Plug-and-Play-compliance but not as versatile.

Resolution vs. Brightness

A monitor's maximum potential resolution (e.g., 1024 by 768 pixels) is determined by its dot pitch—the center-to-center distance between openings in its shadow mask or grill. The smaller the pitch, the closer the openings; the more finer openings you have, the higher the resolution you can achieve.

But you probably should not buy the finest-pitch monitor you can find. An extremely small dot pitch cuts image brightness and contrast. Smaller openings in the shadow mask mean that fewer electrons actually hit the screen, giving a dimmer image. You can think of a monitor's contrast as the difference between its darkest black and its lightest white. The brighter the white, the greater the contrast. You can turn up the brightness to compensate for a fine dot pitch, but if you go too far, the pixels bleed or bloom, destroying the increased resolution that the fine mask tried to give you.

Ultimately, you want resolution and brightness. Why not just increase the electron guns' voltage to illuminate the phosphors more? Unfortunately, as beam current increases, the shadow mask absorbs more electrons, heats up, and deforms. Also, upping the juice makes it harder and more expensive to meet radiation safety standards.

Aperture grills are less susceptible to misalignment, so monitors using Sony Trinitron or Mitsubishi Diamond-Tron tubes can deliver more beam energy to the phosphors and tend to be bright. However, a new warp-resistant alloy for shadow masks, called Invar (for invariable), can withstand the higher voltages needed to produce a brighter display. Most high-quality monitors have Invar masks.

In trading off resolution and brightness, choose a brighter monitor for image editing, multimedia, or graphics work that's not particularly focused on WYSIWYG typography. However, for page layouts, word processing, or other line art and typographical tasks, favor higher resolution over brightness.

phosphors—red, green, and blue—are fully illuminated. The temperature terminology is based on a visual equivalence between the monitor's white and the temperature of a so-called "black body" that emits light when heated, such as in an electric stove's heating element. At room temperature, the element appears black. As its temperature rises, the element appears first deep red (thus the term *red hot*) and then yellow. If you could increase the temperature of the element further, without it melting or burning up, it would look white (white hot) and then bluish white.

At every point, you can measure the temperature of the element in degrees Kelvin (absolute) and associate the color appearance of the black body with a certain white-point color temperature. For example, place a monitor (showing a white screen) next to a heating element. As the heating element's temperature goes up, it will approach the color of the monitor's white screen. At the instant they match, the temperature of the heating element, in degrees Kelvin, is the white-point color temperature of the computer screen. The bluish white of most monitors is 9300° Kelvin. A 5000° white point (what some call paper white) is nearly the same as direct sunlight; this is the graphic arts industry's standard light for evaluating color.

In the Eye of the Beholder

Color is hard to quantify because of imprecise perception and subjective interpretation. If you say "candy-apple red" and "cherry red" to two people, each individual will imagine different colors, because their color sensitivity and past experiences will be different.

Differences in surrounding light affect color perception. An apple that looks so delicious outdoors under sunlight looks quite different under greenish fluorescent lights at home (see the figure "How Red Is the Apple?"). A picture of that same apple on your computer monitor will look different at a 5000° paper-white balance than at the more typical bluish white.

Also, the same apple displayed in front of a bright window will appear duller than when it's in front of a darker surround. This is known as *contrast effect*, and it's undesirable for accurately judging color. Reflections off the monitor face can skew on-screen colors; morning light can shift

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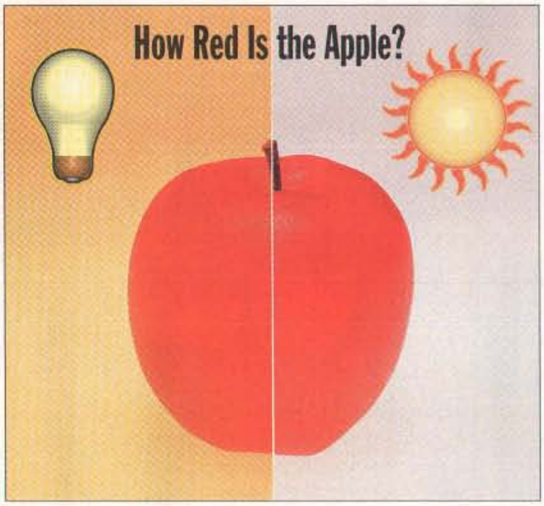
How Red Is the Apple?

Even though both halves of the apple are the same shade of red, differences in surrounding light affect your color perception.

screen colors in a reddish direction, and mid-afternoon lighting will cause a yellow cast. Individual color sensitivity varies; even people with "normal" color vision may be biased toward red or blue.

Altered States

In 1991, NEC (Wood Dale, IL) introduced on its higher-end monitors the first widely available method (called AccuColor) for adjusting the CRT to get WYSIWYP (what you see is what you print) color. Because of NEC's influence on the market, most monitor makers offer similar controls on their 15-inch or larger monitors.

AccuColor and its competitors let you manually adjust the monitor's RGB gain controls. In essence, you can adjust the monitor's tint. If your image of an apple prints fine but looks pale on-screen, you might bump up the monitor's red gun relative to the others. But while this helps you match the apple's red on-screen, the overall white background of your windows or desktop also takes on a reddish tint. You've matched one color at the expense of 16 million others. This is the crudest adjustment for monitor color balance.

Calibrating the Monitor Display

CMSes (color management systems) are software applications designed to adjust all colors—on-screen or the printed output—to produce WYSIWYP color. (For a complete look at CMSes and how they work, see "Consistent Color" on page 93.)

In addition to CMSes working directly with applications software, such as Adobe Photoshop or QuarkXPress, a limited degree of color management is being built into operating systems, notably Apple's Mac System 7.x (ColorSync), Microsoft's forthcoming Windows 95 (using Kodak's Precision Color Management System, or KPCMS), and future versions of SunSoft's Solaris.

Sonnetech produces KPCMS-based software for Windows 3.1, which is distributed with the newest monitors from Nanao, EIZO, Mitsubishi, Nokia, and Idek/Iiyama. NEC recently added Colorific as a no-charge, or bundled, option for every AccuColor-compatible monitor in its line.

A CMS is a filter or equalizer that converts a monitor's original color definitions into those the printer needs to produce matching output. How well this works depends on the accuracy of the conversion formulas and the device profiles used to define the monitor's and printer's individual color-rendering characteristics.

ColorSync and Windows 95 provide default, or generic, "monitor profile" data files to describe the colors on various monitors. They don't provide data on the individual values of the specific monitor you are using. Needless to say, WYSIWYG color matching suffers.

Monitor makers get around this limitation by providing optional or bundled devices called display calibrators. Printer makers, too, are beginning to supply calibration routines in their drivers, enabling you to reset your printer so that you can work better with KPCMS, ColorSync, or other color management systems.

Display calibrator devices maintain colors by measuring—and in some cases, adjusting—your monitor's color characteristics. They also create a "profile" that accurately describes how your monitor shows colors.

Hardware-display calibrators work with the computer's video circuitry, using a suction-mounted photo sensor and a serial connection. They set up a feedback measurement loop between the video signals and the colors that the sensor can see. Hardware calibrators for the Macintosh are available from Radius (Santa Clara, CA), RasterOps (Santa Clara, CA), and Daystar (Flowery Branch, GA). Units for PCs running Windows are available from Radius and Nanao (Torrance, CA).

Other calibrators are software-based working at the operating environment level. Typically, you visually compare on-screen color with supplied color samples. Often these systems use optical illusions that help eliminate the need for special knowledge. With a mouse, you feed information back to the CMS to create an accurate color profile for that monitor in that location. Some systems are tied to specific hardware, such as Radius' ColorComposer, for use with Radius or SuperMac monitors and graphics boards.

In the future, if a monitor complies with the VESA's (Video Electronics Standards Association's) new DDC (Display Data Channel) standard, you can adjust its internal color balance and color response curve (gamma) without knowing anything about the video card, other than that it is DDC-compliant. DDC defines a two-way communications channel that lets the host PC adjust the monitor's color-rendering characteristics to a known state without sacrificing brightness, contrast, or color gamut. It does this by changing electronic gain controls inside the monitor, which gives better dynamic range (i.e., greater on-screen color gamut) than would adjusting (thus limiting) digital values in the graphics board's DACs (D/A converters).

Windows 95's Plug and Play architecture will support DDC, and NEC, Nanao, and EIZO are already shipping DDC-compliant monitors.

Seeing Beyond the Surface

How well does a monitor suppress glare and ambient light? Reflections from the CRT's phosphors themselves need to be reduced, lest they reduce blackness and image quality. To cut or diffuse external reflections, makers treat the CRT's surface by chemical etching, mechanical etching, or applying silica. However, all these methods defocus the screen image a bit.

Another approach is to apply a thin-film AR (antireflective) coating directly on the CRT face (the best and most expensive method), bond AR panels to the CRT, or supply external slide-on panels. A few manufacturers, such as Matsushita, combine thin-film AR coatings with fine-grain silica particles. This provides a more cost-effective method for reducing specular reflections and glossiness without the adverse yield and production issues associated with more costly AR coatings.

A Magnetic Personality

Because a monitor uses magnets to aim its electron beams, it is sensitive to any changes in either external or internal magnetic fields. The larger the monitor, the greater its susceptibility to environmental

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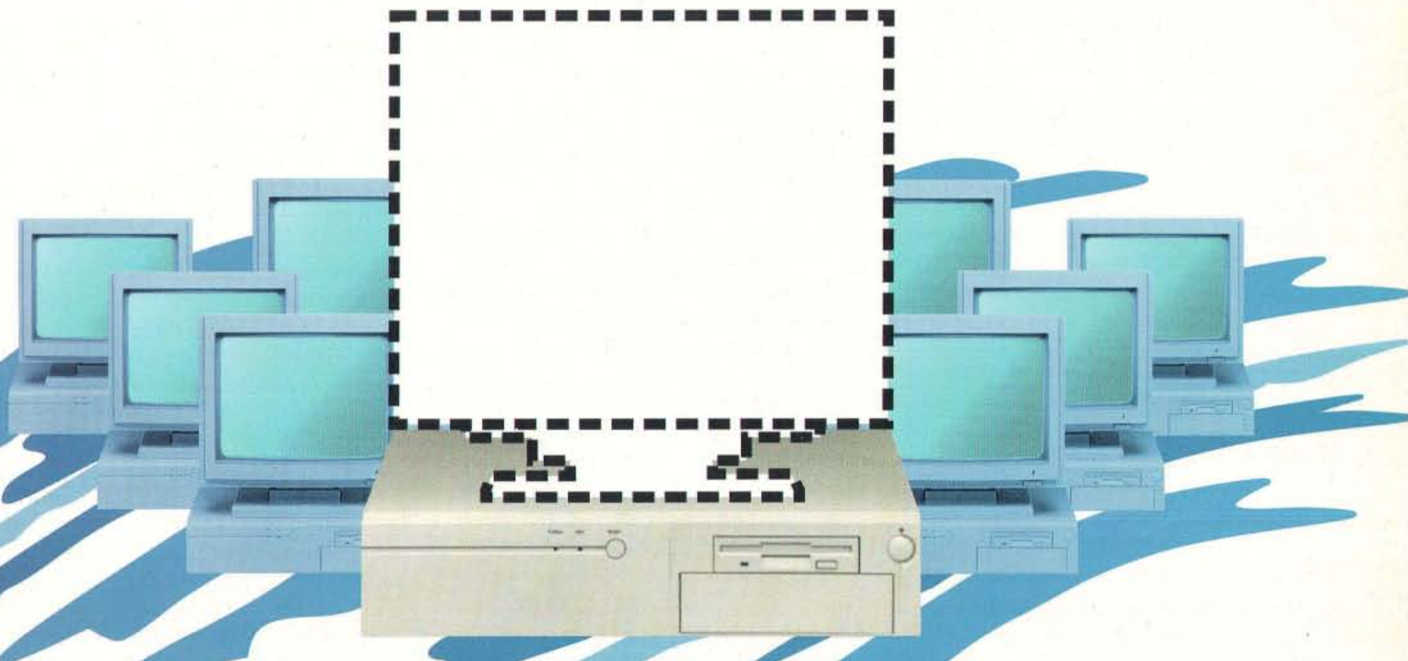

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Flat-Panel Color—Any Good?

Color LCDs are a mainstream technology for laptop computers, and some makers, including Compaq and Apple, have discussed using only color displays on their notebook computers. But are LCDs suited for careful, accurate color work? The short answer: They're usable, but just barely. LCDs will never be good color-proofing devices for WYSIWYG color printing, because of limitations of viewing angle, contrast, and size.

A CRT monitor propagates light over a wide angle—nearly 180 degrees. By contrast, if you look at an LCD from outside its 30-degree viewing angle, it's difficult to see anything on the screen at all. Essentially, if you rotate the screen around a vertical axis, at some point you'll see nothing. Up to that point, the image contrast will steadily decrease, which means that at each angle you view the display from, the color looks different.

Diminished contrast is also an issue because LCD contrast is so low to begin with, compared to CRTs. If power consumption isn't a concern, then LCDs can get fairly bright. Their low end, however, isn't black, because some backlighting seeps through the "off" pixels, reducing the color gamut of LCDs substantially. In addition, bright LCDs get hot, which makes colors drift.

Size is a killer. With windowing GUIs, people want to see more on-screen. A 14-inch LCD won't cut it; the market wants 15, 17, or 21 inches, and producing these is a problem of nightmare proportions. The typical VGA-grade, 9½-inch active-matrix LCD panel has nearly a million transistors. CPU makers manufacture chips with several million transistors, using redundant designs and getting tens of small chips on a silicon wafer. However, LCD makers can't build in as much redundancy, and they can process only a few panels on each glass substrate. To get a large display, they might be able to produce only one panel on a single substrate. With an LCD, each defect is a dead pixel. As size grows, the likelihood of clumps of dead pixels grows dramatically, and manufacturing costs and yields become unmanageable. In the spring of 1994, Sharp announced the world's first 21-inch active-matrix LCD. It produced a single prototype. Clearly, commercially feasible, large-screen LCDs are a long way off.

On the horizon, Texas Instruments is perfecting another flat-panel technology, DMD (Digital Micromirror Device), which puts millions of small mirrors on a chip. Here, too, it's hard to scale this technology up to large sizes, though it seems to have better potential than LCDs. However, there's another problem. According to Jack Roberts of Dataquest, "with LCD's, when pixels are dead, they're off. And this is less noticeable than if those pixels were always on. But with DMD, there's a 50 percent chance that a dead pixel will be off or on, so defects are more noticeable."

variances. Clustered around the neck of the CRT is critical support circuitry, particularly the yoke with its two precisely wound electromagnets. All monitor manufacturers fine-tune color purity and convergence—the beam's ability to strike the screen in the proper place—with magnets that are glued onto the tube at the factory. But during shipping, these magnets can fall off, or the yoke can slip. Thus, it's always best to purchase a monitor from a reputable dealer or maker who will offer service access or no-questions-asked returns.

All monitors automatically degauss (i.e., clear themselves of any stray magnetic fields) when they're powered up. In use, however, the monitor develops a relationship with other strong magnetic fields in its environment, including the Earth's magnetic fields, which are probably the strongest forces. In fact, to achieve the best viewing, position your monitor with the flow of the Earth's magnetic field: face the monitor west in the northern hemisphere or east in the southern hemisphere. Makers such as Nanao and EIZO calibrate their high-quality monitors differently according to their intended destination.

Many monitors allow manual degaussing to remove any stray magnetic effects during operation. These could be caused by poorly shielded power supplies, other monitors nearby, and unshielded loudspeakers. If your monitor sits in one place and never moves, manual degaussing may never be needed. But move your monitor after it's been on awhile, even just swivel it 90 degrees, it will be out of sync with its new magnetic environment. Corners may twist, and colors may slip or smear. It's a good idea to turn your monitor off, degauss it manually at least once a week.

Smaller Boxes, Better Color, Lower Cost

In the future, we can expect shallower monitors based on CRTs with 110-degree beam deflection; today's monitors all use 90-degree tubes.

Also, expect improved convergence, color purity, and brightness uniformity across the face of the monitor. Philips (Nashville, TN) has introduced its Brilliance 21A monitor using a digital technology called CyberScreen to control the beam within tight tolerances.

Typically, a monitor's color purity, white point, and brightness uniformity vary by as much as 25 percent between the center of the display and the corners. To compensate for this error, CyberScreen monitors treat the monitor face as if it were composed of many separate square areas, or tiles. These tubes are preprogrammed at the factory with unique correction factors for each tile—perhaps more correction in the corners, less correction at the center of the screen. Further, the unit's circuits automatically monitor an internal sensor to detect changes in external magnetic fields and maintain picture quality.

The specifications for the CyberScreen monitors are excellent. Misconvergence may be as low as .14 mm versus as much as .4 mm in corners for competitive monitors. And variations in brightness are held to less than 10 percent. This greater uniformity yields improved color matching. You can expect similar technology from Philips' competitors over the next year.

Other new technology in the works will enable image and geometry corrections across the face of the monitor on a scan-line-by-scan-line basis. This will produce big improvements in color purity, brightness, and misconvergence, and other corrections are eliminated in the factory almost altogether—even on 110-degree tubes.

Finally, bigger monitors will continue to come down in price, as more people rely on Windows and other GUI-based operating systems and need displays with more available real estate. By 1996, according to an estimate by Dataquest, 17-inch monitors should be selling in equal numbers to 14- and 15-inch units.

In today's business, academic, and technical settings, color is an integral part of the computing environment; color is an available and increasingly important tool in communicating information and making sense out of data. Almost everyone uses a color monitor these days, something that was not true a few years ago. The net result of increased color requirements, technical improvements, compatible color management software, and market trends will be that tomorrow's crop of color monitors will be better and cheaper than ever. They will provide users with consistent and predictable color that can be tailored to their specific needs and other equipment. And they will help put an end to all those unpleasant surprises at output time. ■

Bill Hilliard is a founder of Sonnetech, Ltd., a San Francisco-based developer of software and hardware to improve color fidelity. You can reach him on the Internet at sonnetech@aol.com or on BIX c/o "editors."

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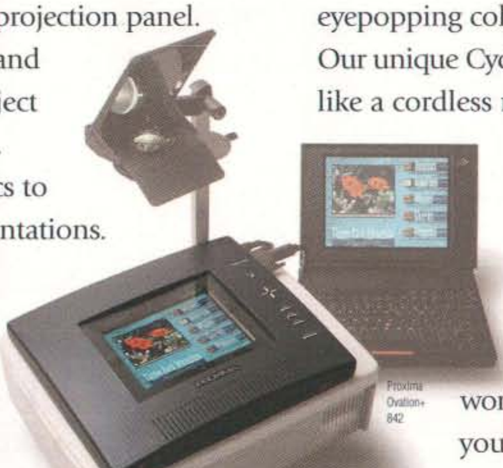

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FINAL OUTPUT

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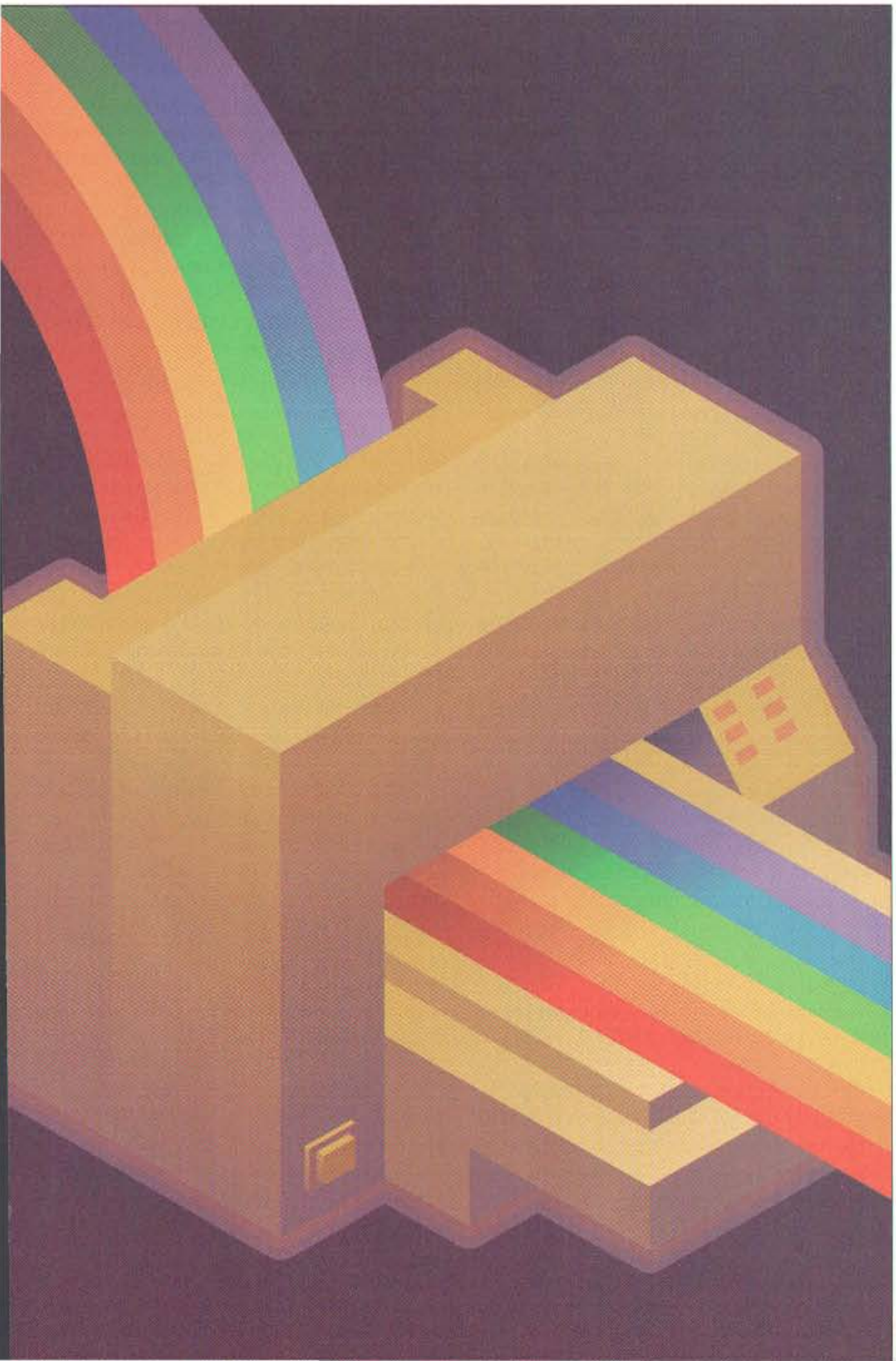


DANIEL PELAVIN © 1995

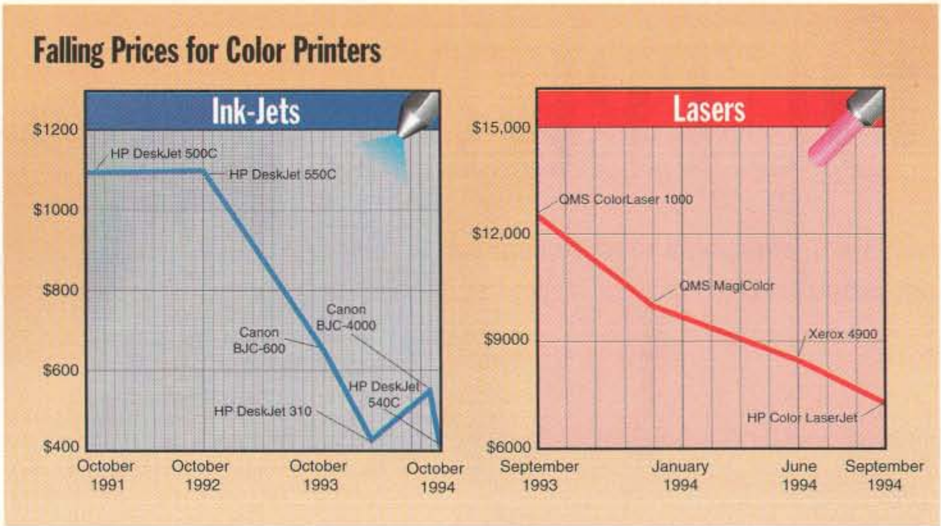
Rapid change is the name of the color-printing game these days. Rising quality, falling costs, new and improved printer technologies, and widely available software that can output color are all contributing to the explosive growth in color printing in a wide variety of settings from home to school to office. These trends will continue over the remainder of the decade at an even more rapid rate.

Accurately predicting what will change is a lot easier than correctly guessing when it will happen. New products with new features will bombard the market—some breakthroughs appear just around the corner; others will need four or five years to perfect. However, the one constant will be that the large number of major industry participants will keep pushing themselves, and consequently one another, to provide users with new and better color printers. There certainly seems to be an industry consensus that color output will become increasingly important.

A compelling argument can be made that technology generates both user interest and software developer support, especially when delivered to the marketplace by Canon, Epson America, and Hewlett-Packard in the case of ink-jet technology or by HP and Xerox for desktop color laser printers. Other highly respected manufacturers, such as Tektronix and Eastman Kodak, have generated similar support by producing specialty products based on thermal-wax transfer and dye-sublimation color-printing technologies.

Liquid Ink-Jet Printing

The most obvious thing about color liquid ink-jet printing is its enormous and growing popularity. Both HP (in 1993) and Canon (in 1994) have passed the 10 million mark in ink-jet printer shipments. HP sold 5 million in 1993 alone, and 2 million of those were color printers. For



Falling Prices for Color Printers

1994, HP expects 60 percent of the ink-jet printers it sells will be color-capable. Indeed, since HP introduced the DeskJet/DeskWriter 320 and 540 and retired its older models, it no longer ships monochrome-only ink-jet printers. In addition to HP, Canon, and Epson, ink-jet printer suppliers include Apple, DEC, Lexmark, Tektronix, Texas Instruments, and Xerox.

The success of liquid ink-jet is due to the printers' continually decreasing cost; improvements in print quality, performance, and ease of use; and effective marketing. Recent advances in liquid ink-jet printing technology include higher resolution, better ability to print on plain paper, faster speed, surprisingly large improvements in print quality, and the ever lower costs. Lightfastness and waterfastness have also improved.

Printing speed is increasing, as the vendors incorporate more nozzles into their print heads. The new Canon BJC-4000 has a 128-nozzle head and prints at 5 ppm (pages per minute) in monochrome. Another development on the horizon is a full-width print array. Canon could build that today, as well as a 256-nozzle head, but not at a price that makes them feasible for desktop printing. In five years, this will change.

According to many industry participants, another major breakthrough will be true medium independence—the ability to print on almost anything. The key to this is ink chemistry, something no ink-jet producer will discuss in detail. Ink chemistry is a key area of competitive advantage for HP, Canon, and Epson, whose R&D departments are working on improvements in pigments, lightfastness and waterfastness, and suitability for printing on a wide variety of media. For example, Canon already has a large specialty printer that uses a 256-nozzle head to print at 400 dpi (dots per inch) on a wide variety of textiles. It prints on T-shirts, and the images do not fade; it also prints on bathing suits, and the ink will not wash off. These advances in ink technology will find their way to the desktop by the end of the decade.

Another area of major improvement that's close at hand is dramatically improved resolution and thus print quality. New printers from Epson and Lexmark entered the market in 1994 that were able to deliver extremely high-quality images because of new printer driver software. Resolution will continue to increase, and this year you will see true 600- by 600-dpi ink-jet printers to replace the so-called 600- by 300-dot-addressable solutions currently on the market. The Epson Color Stylus, used with its software drivers, already claims 720 by 720 dpi.

The next plateau in print quality will be photo-realistic images. In the next few years, units will offer high resolution (600 or 720 dpi) with more depth of color and enhanced drivers to compete with continuous-tone printing from color laser, variable dot-wax transfer, and dye sublimation. Indeed, a number of major vendors believe that the ability to print photo-realistic images at a high speed and keep costs low will be the key to market success at the end of the decade.

Other issues, such as the cost per page, will fall by the wayside. Printing costs will decline with improvements in medium independence, as users will no longer need to purchase special paper. Costs will drop further as competition forces vendors to lower their ink-cartridge prices, which today are still high-profit items.

If liquid ink-jet printers can deliver high quality with robust duty cycles and offer advanced paper handling at speeds comparable to those of laser printers, they will compete aggressively with all color-printing technologies. There are no technical impediments to any of these attributes. In fact, ink-jet printers have a manufacturing cost advantage that should ensure that they remain the lowest-cost color printers in the marketplace. For the foreseeable future, liquid ink-jet will be the color technology to beat.

Solid Ink-Jet Printing

Solid ink-jet, or *phase-change*, technology offers a good deal of promise as well. This technology uses heat to melt the ink material, which at room temperature has the texture of a hard crayon. Once the ink hits the paper or other medium, it cools almost instantly. This attribute makes solid ink-jet perhaps the most medium-independent color-printing technology that is currently available on the desktop—early suppliers of the technology liked to show samples printed on sandpaper and toilet tissue.

Other advantages of this type of printer include the production of vibrant colors that are especially good on transparencies, waterfastness, and true clean-hands installation and resupply. Image quality is excellent, although not currently up to the level of dye sublimation. Tektronix, the leading supplier of solid ink-jet printers, has developed techniques that make monochrome text and graphics quality quite good. On the negative side, solid ink-jet printers print slowly, and they are expensive to buy and operate. Also, the color is not very lightfast; it tends to fade quickly when exposed to sunlight.

Tektronix has made significant R&D investments in the technology and is clearly aware of the current shortfalls. There is every reason to believe that its next generation of printers will be at least twice as fast as the current Phaser 300i, which doubled the speed of the first-generation Phaser III PXi.

There is nothing inherent in the solid ink-jet technology that would inhibit it from being competitive with desktop color laser solutions. A. J. Rogers, strategic marketing manager of the Tektronix Color Printing and Imaging division, likes to say that "it has the simplicity of liquid ink-jet without the drying-time problem." Solid

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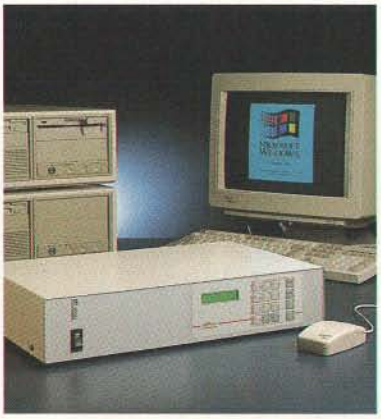

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ink-jet printing is already fully medium-independent and is more reliable and easier to use today than color laser printing. Further, the lightfast problem seen in Tektronix offerings can be overcome: Brother offers a solid ink-jet printer that uses a pigmented ink that is much more resistant to fading.

Major solid ink-jet improvements need to occur in two areas: performance and price. Speed is the easier of the two to achieve. The next generation of solid ink-jet products, due out this year, is likely to comprise true page printers with the ability to print color at least as fast as current color laser printers. Price breakthroughs will be contingent on higher sales volumes that would dramatically reduce manufacturing costs. To do this, solid ink-jet printers will have to keep pace with the print-quality improvements expected for both liquid ink-jet and color laser technologies.

Solid ink-jet color-print quality is already good for graphics and will improve with further development. However, text quality must be improved, especially in monochrome, to compete successfully with laser printers. It seems clear that color laser printers will improve to match monochrome laser quality with increased resolution, moving from 300 to 600 to 1200 dpi using smaller toner particles and resolution-improvement techniques. Solid ink-jet devices will have to match the higher resolution and better text imaging. There are no basic technical impediments to this, but print quality comparable to today's monochrome laser printers is probably two generations of solid ink-jet printers away.

Solid ink-jet/phase-change technology shows good promise for the end of the decade. By then, these printers are likely to have a small footprint, speeds that match desktop color lasers, and prices in the $2000 to $3000 range. With those specs, the technology should remain attractive to many.

Color Laser Printing

Color laser printing is currently the hottest printer topic. At this writing, four vendors were supplying desktop color laser printers: QMS, Xerox, HP, and, just about to appear, Tektronix. They offer speed, adequate text quality and color that is good enough for general-office printing, and address-networking capabilities. As with all new technologies, they still command a price premium, but prices are dropping quickly. The 12-ppm monochrome HP LaserJet 4 Plus sells for $1839, and the color LaserJet costs $7295.

Unfortunately, there are a number of difficulties with color laser printing today. First, it is far from clean: Toner installation is a messy procedure. Moreover, some units require surprisingly frequent intervention by users to service components. As a consequence, they are significantly harder to live with than other color-printing technologies or monochrome lasers.

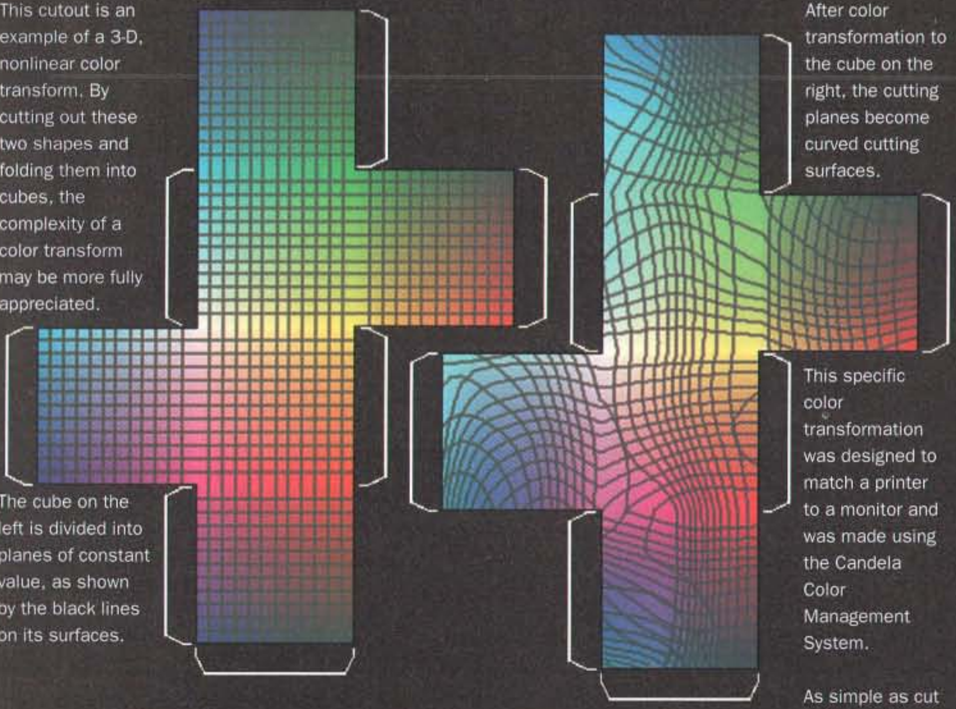
Another disturbing issue, hopefully temporary, is that the QMS and Xerox models (both using Hitachi's color-laser engine), appear to be mechanically fragile. Users report needing higher-than-normal numbers of service calls to keep these printers working properly. The HP Color LaserJet does not appear to suffer from this problem. The Tektronix offering is unknown because it was unavailable at press time.

Perhaps the most serious problem with color laser printers is lower print quality than what users are likely to expect. The QMS, Xerox, and HP devices don't support continuous tone reproduction; they must create combination colors using halftone (dot-pattern) screens. The new Tektronix desktop laser printer does use continuous tones; its overall quality should compare favorably to the imaging capabilities of the larger and more expensive Canon and Xerox machines. Note, however, that text quality for desktop color laser units, such as the HP Color LaserJet, does not compare with today's office standards set by 600-dpi monochrome printers, although it may be good enough for most purposes.

Because color laser printers are still in their infancy, today's difficulties should not be viewed as a failure of the technology. Over the next five years, all vendors' color laser printers will become simpler and more reliable. The next-generation devices should be capable of clean-hands installation and require minimal user intervention. Quality will go up quickly, as will speed.

Today, you have to compromise to get affordable quality color. By the end of the decade, you won't have

Build Yourself a Color Transform



This cutout is an example of a 3-D, nonlinear color transform. By cutting out these two shapes and folding them into cubes, the complexity of a color transform may be more fully appreciated.

The cube on the left is divided into planes of constant value, as shown by the black lines on its surfaces.

After color transformation to the cube on the right, the cutting planes become curved cutting surfaces.

This specific color transformation was designed to match a printer to a monitor and was made using the Candela Color Management System.

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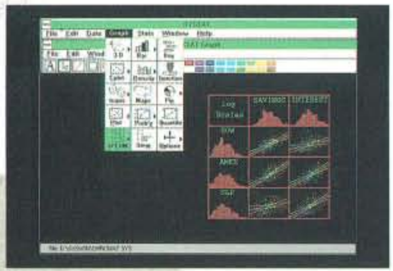

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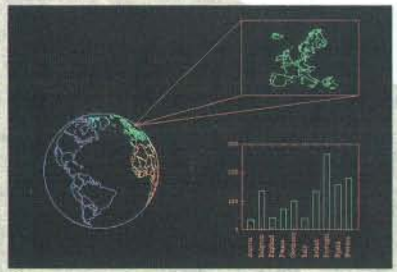

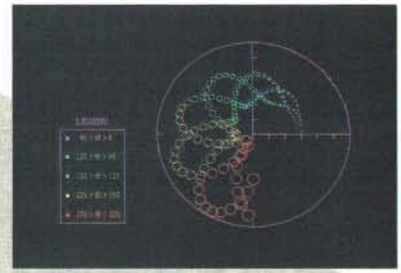

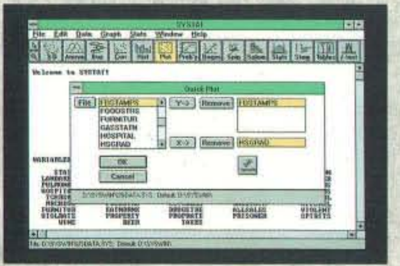

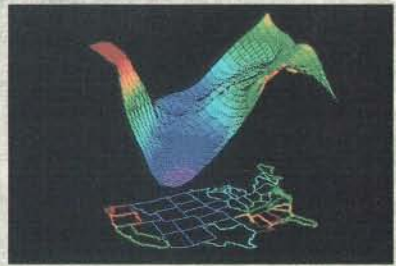

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to. The one open issue is cost. If color laser-printer prices reach the $2000 to $3000 range, they will likely find their use in higher-end desktop environments, while comparable ink-jet printers will occupy the low end and midrange.

Thermal-Wax Transfer and Dye Sublimation

Compared with ink-jet or laser printers, today's thermal-wax transfer and dye-sublimation printing technologies are more specialized (i.e., less versatile). Each has clear technical strengths and weaknesses. Both have good color-imaging characteristics. TTP (thermal-transfer printing) produces excellent transparencies, while dye sublimation is the clear leader in producing photo-realistic images.

Perhaps the greatest drawbacks of both technologies are their cost and their requirements for special media. Both are quite expensive on a cost-per-page basis, and dye-sublimation units are expensive to purchase. Further, the cost per page for TTP is fixed—the cost per print is unaffected by the amount of color on a page because the process uses a full block of transfer ribbon for each page printed. These ribbons are expensive, their pricing largely controlled by patent-licensing arrangements.

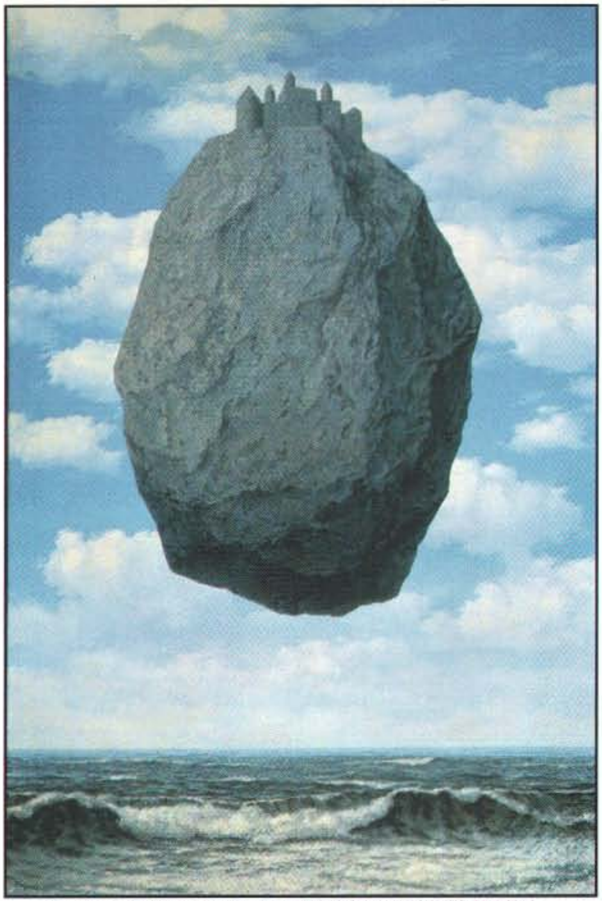
Achieving best quality from TTP requires special medium. The slick paper that gives thermal transfer an optimum base for printing also makes it impossible to integrate transparently into a larger document. Attempts at plain-paper solutions have resulted in lower print quality.

Dye sublimation has similar drawbacks. As with thermal-wax transfer, ribbon use is fixed and expensive. The one bright light here is that dye-sublimation ribbons are not bound by the same proprietary pricing constraints as thermal wax, so you are likely to see a dramatic cost-per-page reduction. The process will continue to command a premium over other types of color printing, however, because of paper costs. The paper needed for dye sublimation is an expensive, photographic-grade stock.

You can also expect dye-sublimation mechanisms to become significantly less expensive in the next few years. As host processors become more powerful, some printer manufacturers will provide "dumb" dye-sublimation printing devices with radically reduced prices. They might be slower, but they will also be much less expensive, while still providing excellent imaging capabilities.

Other advances will also be made. The new Eastman Kodak 8600 dye-sublimation

Outstanding.



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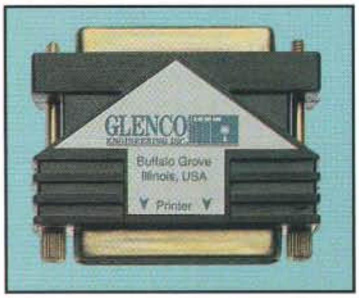

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printer provides much better lightfastness than has been previously achieved. Additional improvements in image quality also can be made, although devices are likely to remain at the 300-dpi level, simply because higher resolution is not particularly important for continuous-tone rendering.

By the end of the decade, users should expect fast, clean, easy-to-use, and inexpensive color printers. Color quality will be high, and output will be much more waterproof and lightfast than today. It seems likely that all printing technologies will converge and deliver similar capabilities to users.

The performance of thermal transfer and dye sublimation differ considerably. Dye sublimation is a slow technology, while some of the fastest color printers on the market are TTP units. In extensive benchmark testing across technology lines, the Tektronix Phaser 220e and 220i achieve better throughput than any other color device tested—this includes liquid-ink, solid-ink, dye-sublimation, other thermal-transfer products, and some color laser printers.

Although both processes can produce generally good images, there are still significant image-quality problems. Both experience problems producing text in small point sizes with good character shapes and smooth edges. In addition, both have trouble with fine-line detail, especially hairlines printed perpendicular to the paper path. These problems are inherent in the technology because it is difficult to quickly heat and cool individual pixels to produce fine levels of detail under certain circumstances.

Considerable creative effort has also been invested in developing machines that can serve new users and new applications where the inherent drawbacks are less significant. Fargo and Seiko Instruments have dual-technology devices that can produce thermal-wax transfer and dye-sublimation output, and a variety of vendors have introduced large-format printers in the 24- by 40-inch class.

More improvements are on the way. In the next 12 to 24 months, true 600-dpi thermal-transfer printers will be available. Another 1995 print-quality improvement will be the use of variable-dot printing, where dots of varying sizes will replace today's dithering techniques that incorporate same-size dots. The process will require more memory in the printer but will produce print quality midway between traditional thermal transfer and dye sublimation. Products using these new technologies will be faster than dye-sublimation printers, perhaps down to only 2 minutes per page. Media costs will also be lower.

From a marketing perspective, dye-sublimation and thermal-wax transfer technologies will remain competitive through the 1990s: Their excellent print quality will ensure their use in specialty markets. But beyond that, they will be under increasing pressure from the other color-printing technologies in terms of both image quality and cost. And they've already lost the speed battle.

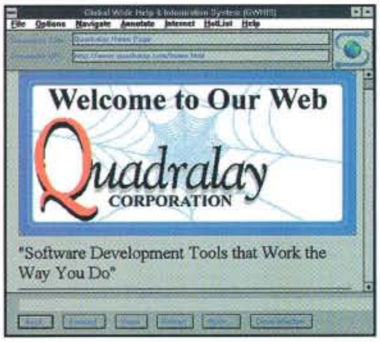
Closing the Gap

All the major desktop color-printing technologies have a mix of strengths and weaknesses. The suppliers are aware of all the shortfalls and are working to correct them as quickly as possible. By the end of the decade, users should expect fast, clean, easy-to-use, and inexpensive color printers. Color quality will be high, and output will be much more waterproof and lightfast than it is today.

What is absolutely not clear at this point is which—or whether—one of these technologies will emerge as clearly superior to the others. It seems more likely that all the printing technologies will converge and deliver similar capabilities to users. Printer prices will drop, as will cost per page. Each technology will still have advantages and disadvantages, but they will be small and may matter only in certain applications. In the end, technology itself will probably not be the principal determinant. For color printing, says Ron Patten, senior product-marketing manager at Seiko Instruments, "success will be determined by marketing, not by technology." ■

Michael Weiss is president of MWA Consulting, Inc., of Palo Alto, California, an industry-analyst organization that focuses on printing and imaging issues. You can contact him on the Internet at mwac@applelink .apple.com or on BIX c/o "editors."

BYTE Special Report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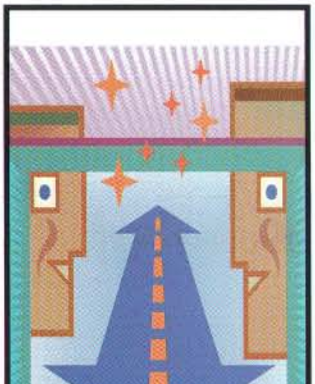

The Virtual Storefront

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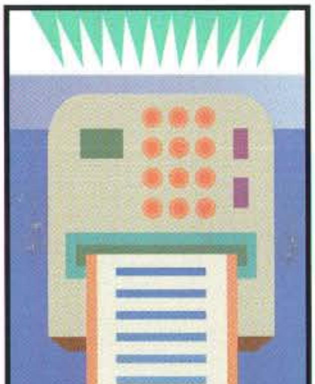
page 125



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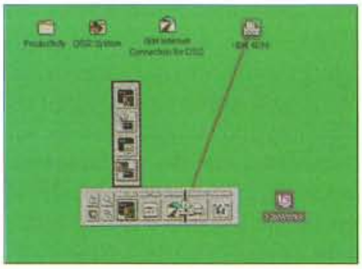

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Special Report

Small-Office

PAULINA BORSOOK AND MICHAEL NADEAU

According to the U.S. Statistical Abstract, 97.8 percent of all nonresidential businesses are classified as small businesses (100 or fewer employees). Of those, says research firm IDC, about 67 percent own PCs. To stay in the market with larger, more powerful competitors, these small businesses must do things better, cheaper, and faster. The same holds true for large companies' independently run satellite offices. The best hope of these small businesses, next to their wits, is to make better use of new technology than their larger competitors.

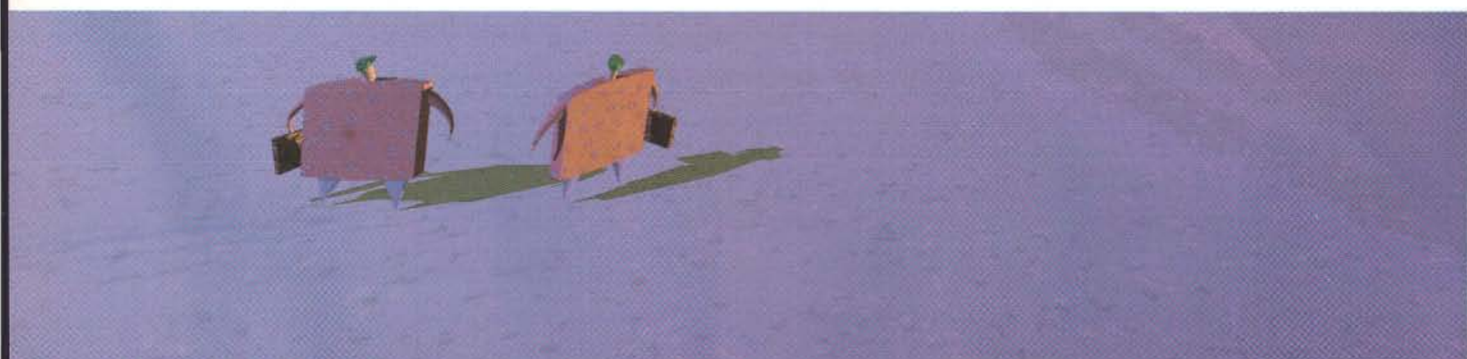
Small companies or independent employees of larger companies can get a leg up by intelligent use of new technology

Sure, large companies have their multimillion-dollar enterprise networks, but this kind of infrastructure comes at a price: inflexibility. Before it can implement new technology, a large company must show that it will both provide a payback and be compatible with existing infrastructure. The evaluation process can take years.

Small companies can quickly justify and implement new technology, which gives them new competitive tools to reach customers and suppliers, to access numerous resources, or to do administrative chores more efficiently. Take communications, for example. Low-cost options now allow small offices to implement conferencing using both voice and data on the same line (see "Doing It All on One Line," on page 145), or to integrate Caller ID features into their applications (see "Caller ID Goes to Work," on page 149).

Even applications commonly found in large companies can give smaller organizations a boost when used innovatively. For example, few large companies go to the lengths to optimize the effectiveness of E-mail as has Orbit Software (Danville, CA), a highly decentralized international provider of backup and storage software for Hewlett-Packard 3000 and 9000 machines. The seven-person Orbit sales office and corporate headquarters is connected by a 56 Kbps line to the R&D site 40 miles away in Novato, which itself maintains 19.2 Kbps connections to programmers working in Oakland and San Jose, as well as in Seattle, Washington. What's more, dial-up E-mail connections exist between headquarters and each of the seven international Orbit offices, each only staffed by about three people. Any office can connect to any other Orbit office at any time.

Orbit uses E-mail to provide better service to customers: When a client is having a problem that the local Orbit office can't solve, E-mail provides company



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Computing

president David Merit with instant and complete documentation of the problem by the time he gets the customer on the phone. In fact, it's likely he's been monitoring the problem through E-mail as it developed. E-mail might also allow an Orbit staffer in Singapore to solve the problem of a customer in Belgium. "People are really impressed by our E-mail system," says Merit. "They tell us 'even HP doesn't do this!'"

Winning an account or getting a product to market first often means having access to the information you need when you need it. One resource still very much under-used by many large companies is the Internet. Not only is the Internet a vast storehouse of information, it can also serve as a low-rent storefront for many business. "The Virtual Storefront," on page 125, explains how to get the right Internet connection as well as how to set up an on-line shop.

Performing everyday administrative chores such as billing or bookkeeping is not just aggravating; it steals time and resources away from important revenue-generating tasks. This is especially true for small offices that often cannot afford to hire secretaries or accountants. Help is on the way from companies such as Intuit and Peachtree. These companies are using on-line resources and cross-application data links to shave hours off common accounting tasks (see "High-Tech Bookkeeping," on page 155).

For the small company competing with giants, new technology can be the great equalizer. For the independent employee looking to get ahead, new technology can be a great enabler on the way to the top. ■

Paulina Borsook is a San Francisco-based writer who has written about security issues for BYTE. Michael Nadeau is a BYTE contributing editor. You can reach them via the Internet at loris@well.sf.ca.us and miken@bix.com, respectively.

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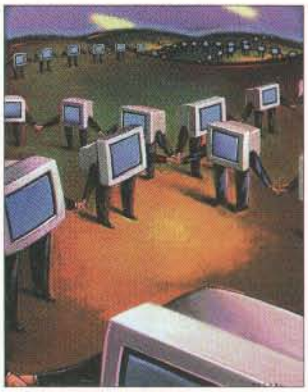
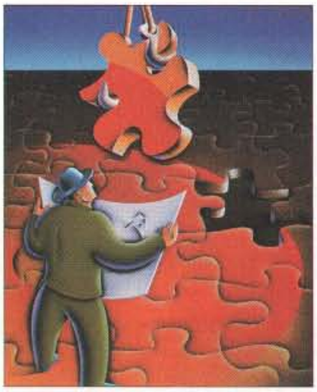
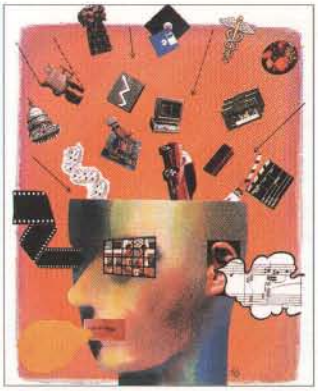


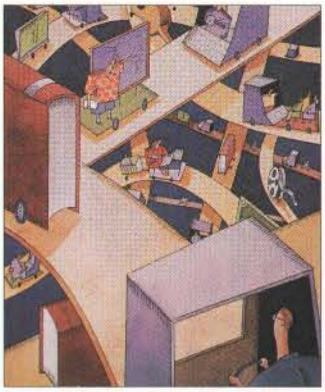
Network utilities—vital, but set aside 100K



DOS 6 utilities—handy, but about 120K



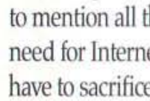
Multimedia—fun, but can you spare 50-80K?



Internet utilities—where will you get 120K?

If you don't have QEMM 7.5, what else have you sacrificed?

Sooner or later, as you push the limits of your PC's capabilities, you will run into a wall. Memory limits. Drivers that won't load. Crashes. "Out of Memory" messages. And you'll run into this wall whether you have one megabyte in your PC or 16.



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MemMaker, the memory utility that comes with DOS 6, does an OK job of delivering additional memory, but it just hasn't kept up with demanding users.

Say you wanted to run a mouse, sound card, SmartDrive, your DOS 6 and Novell utilities, and your Microsoft Bookshelf '94 CD ROM. You couldn't with MemMaker. Not unless you were willing to manually 'tune' it. And then you might end up with 490K or so to use. But QEMM 7.5 routinely returns 634K of conventional memory. And when you consider as little as one 'K' of memory makes the difference between a program loading or not, you can see where an additional 140K or so could be vital.

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The Virtual Storefront

ANDREW SINGLETON

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Corporations both great and small have invaded the Internet in a virtual land rush. Fortunately, this new universe is big and accessible: Anybody can stake a claim. Retail space on New York's Fifth Avenue may have limited availability and sky-high prices, but any business can have a Fifth Avenue address on the Internet.

Space is not a problem. Even though the Internet's current 4 billion *IP addresses*, which identify a given computer, may one day get used up, a standards committee is currently working on an addressing method known as *IP–next generation*, which will add a few bytes to each address and satisfy any possible galactic demand.

While this committee busily clears space, an organic growth known as the WWW (World Wide Web), or simply the Web, is obliterating distance. On the Web, no destination is more than a few mouse-clicks away.

The Web is an endless expanse of hypertext. Each hypertext document resides on a server and has links to other documents. These linked documents can be located on any server joined to the Internet, whether they're on the same server or on different servers in different countries.

Here's a typical scenario: A user reading a document from the NCSA (National Center for Supercomputing Applications) server in Illinois selects a link that reaches across the Atlantic and grabs a document from the CERN (European Laboratory for Particle Physics) server in Switzerland. Because the Internet was originally a government-subsidized research tool, the majority of the information and software available on it is free. CERN (the creator of the WWW), NCSA (the creator of the Mosaic browser), and many other individuals and organizations offer free Web software.

The players in Internet commerce are small companies. Prominent service providers, such as BBN Internet Services (Cambridge, MA) (i.e., Nearnet and Barrnet) and Alternet (Falls Church, VA), have revenues of $10 million to $20 million per year (about 1/5000 of AT&T's annual revenues). Retailing giant Home Shopping Network recently bought the Internet Shopping Network, the most prominent direct-marketing company on the Internet. The deal was front-page news in national publications such as the *New York Times* and *USA Today*. At the time, the Internet Shopping Network had just eight employees and one network server.

On the Internet, no one needs to know how small your business is

Businesses want to use the Web for a number of reasons. Because it was designed as a publishing medium, it holds a particular interest for publishers. On-line distribution services, such as CompuServe, Lexis/Nexis, and Reuters, can take more than half of the revenues from each sale. With Internet distribution on the Web, a small publisher can cut out the middleman and capture a much greater revenue share, as well as maintain a unique look and feel. Furthermore, Web distribution is faster than producing and distributing a book, magazine, newsletter, or CD-ROM. Timeliness is especially important for newsletters and financial analysis.

The multimedia capabilities of the Web, which enable the delivery of pictures and sound as well as text, make it a great venue for distributing marketing literature. Many corporations provide what is known as a *home page*, which has the company's logo and motto and a menu of choices for background information, product information, and news. Background information often includes pictures and résumés of the company's principal officers. A news section might include a list, in reverse chronological order, of product announcements. Product information can be expansive, including such items as a full catalog, service examples and endorsements, and technical specifications.

In addition to catalogs, order forms can be distributed on-line as well. Direct marketers on the Internet allow customers to submit an order by simply pushing a button and filling out a form. A password authorizes a customer to run up a tab, and encrypted transactions allow customers to

Making the Internet Connection

BEN SMITH

Most small- to medium-size businesses do not have a connection to the Internet. The main reason for this is that it's orders of magnitude easier to get a phone line connected to your office than it is to get a connection to the Internet.

If you want to be an Internet information provider, your Internet connection needs to be the best IP connection that you can afford. However, that's difficult to achieve.

If your business needs to be only a consumer of Internet resources, the simplest way to get access is by subscribing to any of the commercial information exchanges that have recently added Internet access. This access, however, is usually limited.

The second line of access is through dial-up Internet-access providers that provide you with *shell* accounts on a server. These systems are specifically built on traditional Internet-server platforms, so they provide all the service that you'd expect to get if you had your own Internet server in your office that included Usenet news, Internet E-mail, FTP, and many other Unix utilities.

One of the best-known dial-up access sites, The World, is located in Brookline, Massachusetts. Like subscribers to the large information exchanges, subscribers to The World can access the server by dialing in directly, either through The World's own network of access points or through the CompuServe Packet Network, the U.S. nationwide communications network. (You don't have be a subscriber to CompuServe to use this access.) On the West Coast is a famous server called The WELL (Whole Earth 'Lectronic Link). Yet another is CERFnet, which offers toll-free dial-up service.

Another notable dial-up service is The Pipeline, located in New York City. By using a proprietary communications protocol, you can achieve many of the attractive features of Mosaic at a fraction of the cost of other services. The Pipeline includes E-mail and Usenet news, along with some Internet-browsing tools, all with a common user interface. As with Mosaic, the client program is free (see the screen below).

There are other advantages of using dial-up access. For example, all the processing, file retrieval, and caching takes place on the remote servers and doesn't burden your system with the storage and management of all those files.

But there are disadvantages as well: You are totally reliant on the remote system for access methods and control. Your connect time is determined by the speed at which you read the text on the remote system, not by the potential bandwidth of your connection. (Chat scripts, which automatically log in and download files for local viewing, can eliminate this problem.) Finally, you are often limited to just text. True, you can retrieve images, but the process of retrieval and viewing is not integrated into the search-and-retrieval method. The only way to eliminate these limitations is by tying your system to the Internet using UUCP or TCP/IP, the Internet's native protocols.

Internet Protocol Connections

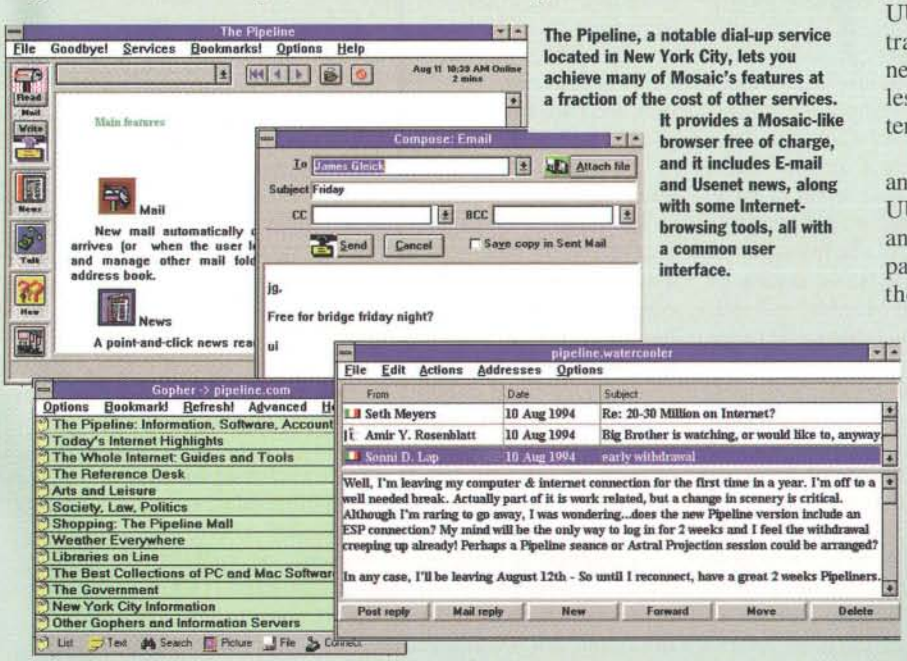
UUCP is the Internet protocol that is the least expensive to implement. It's the modem-to-modem protocol that's traditionally used to distribute E-mail and Usenet news. You need to have your site connected to get your E-mail and news via UUCP. UUNET Technologies (Falls Church, VA) operates the most famous and the most connected dial-up site in the U.S. Being a UUNET client has another advantage: You're connected to one of the most important archive sites—a computer system that has copies of the most popular freely available programs and information files.

With UUCP, you can not only send and receive E-mail and Usenet news but also retrieve files from the systems that you're connected to. Since all files on all UUCP connections can be automatically transferred among machines, the connection time and phone charges are much less than when you use a modem to interactively read a file on another system.

Even better than a UUCP connection to an Internet site is an IP connection. While UUCP is a store-and-forward protocol-and-networking design, IP and its companions, TCP and UDP, are the basis of the fully connected client/server networking that represents most of the Internet today.

You don't have to have a Unix or VMS server at your end to take full advantage of an IP connection. There are plenty of client programs that you can run on your MS-DOS, Windows, NT, or Macintosh computer, Mosaic being the most modern of them. But first you need to get an IP connection.

There are many places to go to obtain an IP connection, as well as many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- Weather Everywhere
- Libraries on Line
- The Best Collections of PC and Mac Softwar
- The Government
- New York City Information
- Other Gophers and Information Servers

From	Date	Subject
Seth Meyers	10 Aug 1994	Re: 20-30 Million on Internet?
Amir Y. Rosenblatt	10 Aug 1994	Big Brother is watching, or would like to, anyway
Sonni D. Lap	10 Aug 1994	early withdrawal

Well, I'm leaving my computer & internet connection for the first time in a year. I'm off to a well needed break. Actually part of it is work related, but a change in scenery is critical. Although I'm raring to go away, I was wondering...does the new Pipeline version include an ESP connection? My mind will be the only way to log in for 2 weeks and I feel the withdrawal creeping up already! Perhaps a Pipeline seance or Astral Projection session could be arranged?

In any case, I'll be leaving August 12th - So until I reconnect, have a great 2 weeks Pipeliners.

The Pipeline, a notable dial-up service located in New York City, lets you achieve many of Mosaic's features at a fraction of the cost of other services. It provides a Mosaic-like browser free of charge, and it includes E-mail and Usenet news, along with some Internet-browsing tools, all with a common user interface.

ways of implementing it. A small business may not need—or be able to afford—a full-time, leased-phone-line connection to the Internet. Two IP connection-on-demand alternatives might be sufficient: SLIP and PPP.

SLIP is a simple and nonstandardized, but widely available, protocol that requires few resources to implement or install. It was designed for relatively low-speed modem-to-modem connections and low loads.

PPP, on the other hand, offers standards, flexibility (i.e., you can implement more than TCP/IP over it), and optional security. However, it not only requires more sophistication to implement and install than SLIP, but it also needs more bandwidth overhead from the serial connection to run.

Many of the larger dial-up-connection providers that offer shell accounts also offer SLIP and PPP connections. Be sure to work out your local system's communications logistics before you approach a vendor for a connection. Steer around any protocol and system incompatibilities when searching for the best connection provider. If you are achieving your IP connection from an MS-DOS or Windows PC, the application that you run on it for navigating the Internet must be an application that the connection provider can ensure will work with its system.

If you find yourself in need of a local network with a TCP/IP connection to the Internet, you've entered a world of servers, routers, and system administration. You've become a member of the Internet, with all its associated powers, privileges, and responsibilities.

It's possible that errors on your network may cause problems for other members of the Internet once your little LAN is going to be seen in some form in the outside world. You must have registered and approved IP addresses, network-domain names, and IP ports and services. If you're doing an IP-LAN-to-Internet connection for the first time, you may need some on-site help to get up and running cleanly.

Ben Smith is a consultant, a former BYTE Lab testing editor, and the author of Unix Step-by-Step *(Hayden Books, 1990). You can reach him on the Internet at ben@ronin.com or on BIX as "bensmith."*

submit a credit card number or even pay with "digital cash" (which I'll describe in detail later). This type of shopping is gratifying for the consumer and provides an extremely low overhead for the vendor.

The Internet also makes after-sales support more efficient. Vendors can distribute product documentation on the Web and provide support by E-mail. To help get sales transactions started, prospective customers can often send E-mail to info@the target vendor.

Building the Virtual Storefront

The following steps describe how you can set up a home page on the Web to display your company's marketing material, offer goods and services for sale, and collect information or orders from clients.

Step 1: Install a Web browser. To do your initial research, you'll need one essential tool: a Web browser. These browsers are often based on the Mosaic GUI front end (see the screens on page 130). Refer to one of the many available introductory books about the Internet and find a table that lists Internet service providers. Select a provider that offers 14.4-Kbps or 28.8-Kbps dial-up SLIP or PPP service.

A Web browser gives you access to the sources listed in this article by their URLs (uniform resource locators). The URL http://www.store.com/catalog.html, for example, has three parts: a server protocol, a host name, and a source name. When you type this URL, it seeks out an http server on the computer www.store.com and asks for the file catalog.html.

Step 2: Get a good name. Every company on the Internet has a name. In the name *money.com*, for instance, *money* is reserved by a company as a domain name; *.com* indicates that it is a commercial organization. Individual computers at an organization use prefixes; for example, one computer at this company might have the name vault.money.com.

It's wise to reserve your name promptly. The U.S. government pays InterNIC to register these names on a first-come, first-served basis. Your Internet service provider can check to see whether your desired name has already been taken and submit an on-line name request for you. For more information on reserving names, see http://www.internic.net.

Step 3: Select a service provider. You must find an Internet service provider to connect your server with the world. Since this vendor will be a combination of landlord and essential utility, it's important for you to be comfortable with your choice. A provider should be able to give you satisfactory technical support, especially in the early stages.

Service providers can be big or small. Big service providers have a regional or nationwide presence and lease their own networks to carry Internet traffic from your local POP (point of presence) to the interchanges. These providers maintain space-age mission-control consoles, called Network Operation Centers, and they can track down the cause of any errors that occur in network transmission. Small service providers rely on Sprint to carry their traffic across the country and typically have a single POP maintained by a couple of hackers. They can't track down errors as well as a Network Operation Center can, but they cost less and can give you personal attention (see the text box "Making the Internet Connection" at left).

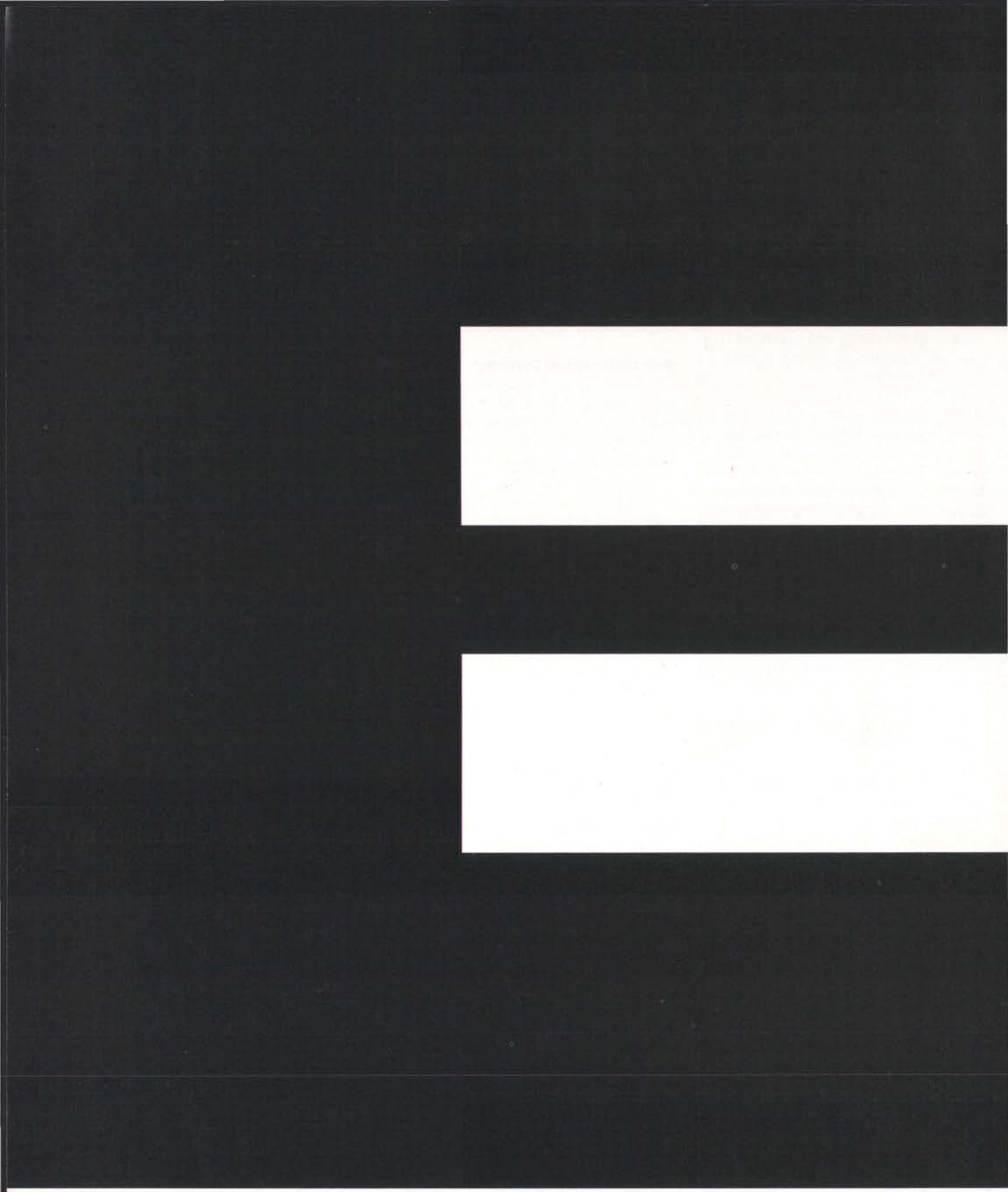
Step 4: Consider connectivity alternatives. To keep your server connected and open for business at all times, you need to use a leased line, a co-location, or host services. As recently as last year, the leased-line method was the only way to place a server on the Internet. You had to find an Internet service provider and pay a substantial lump sum to install a network port. Then you or your provider arranged with the local phone monopoly to provide a leased line from the provider to your office, paying another installation fee in the process. Then you bought a router and plugged your server in. After a cost of approximately $15,000 and three months' worth of work, you were finally on-line (see "Connectivity Costs" on page 130).

Once installed, a leased line is reliable and fast and gives your workstations seamless access to other network services. It remains the only practical way of providing high-volume connectivity for an office network.

With leased lines, you pay a fixed fee according to the size of your pipe. Leased lines come in several speeds, from 56 Kbps up through T1, or 1544 Kbps. The phone company uses these denominations for carrying digitized voice conversations, where 56 Kbps carries a single conversation and T1 carries 24 conversations.

The least expensive and easiest alternative is a 56-Kbps line. Although 56 Kbps does not seem like much bandwidth—an ordinary modem can carry almost the same amount of data at 28.8 Kbps compressed—it is appropriate for a small Web server. If you become a heavy Internet user, however, you should proceed directly to T1.

Several trends have recently evolved to make leased-line service more palatable for small businesses. Competition among



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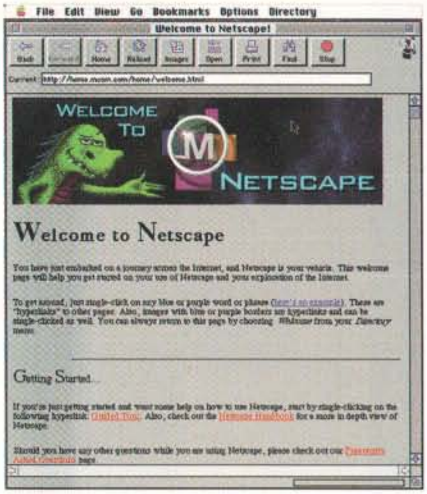
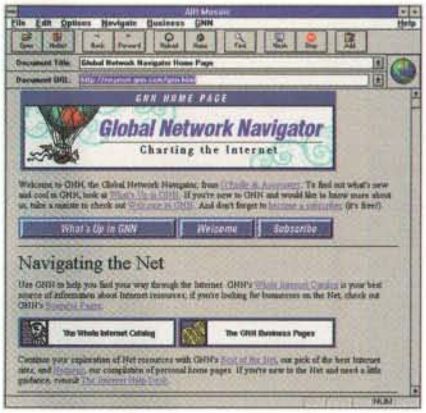
providers has reduced the installation fee to as little as $400. The local phone companies face competition as well, from local fiber networks installed by Teleport Communications Group (Staten Island, NY) and MFS Telecomm (Oakbrook Terrace, IL); this may give you a choice of carriers.

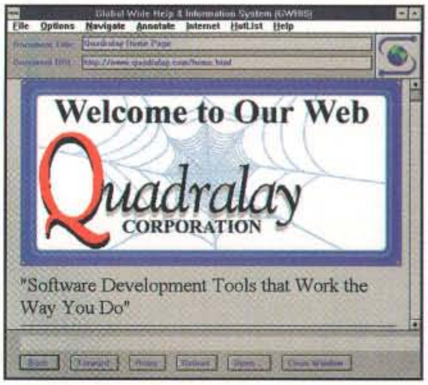
By popular demand, many Internet service providers now offer much less expensive ways, such as co-location and host services, to open up shop on the Internet. *Co-location* involves placing a server at the service provider's site. *Host services* include FTP, Gopher, and Web servers maintained by the Internet provider. Both of these options eliminate the expense of communications equipment and a leased phone line.

The big service providers would rather sell you a leased line and all the extras and collect the installation charge, but smaller providers can give you co-location services for as little as $150 a month plus a per-byte usage fee. Host services can cost even less.

With these services, the server is located in someone else's office, so you just provide the published content of your company's information from your office or home. To update the remote server, you dial up the Internet with your modem or ISDN account and then use FTP to send new or improved hypertext files. Your provider should be able to route any E-mail responses to your dial-up account.



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Document URL: http://www.quadralay.com/home.html
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Three Mosaic browsers. From top to bottom, they are Netscape, from Netscape Communications; AIR Mosaic, from Spry; and GWHIS, from Quadralay.

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FOR A T1 TELEPHONE LINE:	
CSU/DSU	**$1500**
Leased-telephone-line installation	**$400–$1700**
Internet-provider installation	**Up to $5000**
Leased-line charges (per month)	**$400–$1000**
Internet-provider charges (per month)	**$1000–$4000**

Step 5: Set up a Web server. Once you are connected to the Internet, you need to run a piece of software known as an HTTP server (also called a Web server). Many Web servers with similar capabilities are listed for downloading at http://info.cern.ch/hypertext/WWW.Daemon/Overview.html. (Note that many URLs are case-sensitive.) The two most popular ones are written in C for Unix computers—one from CERN and another from NCSA.

Traditionally, Web servers run on Unix workstations, and you can find binary versions for machines from DEC, Hewlett-Packard, IBM, Silicon Graphics, and Sun. A budget-minded small business should consider Linux, a free Unix clone that runs on PCs.

Unix machines come with Internet daemons, such as FTP and Telnet, already installed. They have powerful script languages for handling forms and database requests, and they can handle numerous users. The main disadvantage of these daemons, however, is that you must have a good knowledge of Unix to find and edit their many configuration files.

If you find the prospect of becoming a system administrator for a Unix machine daunting, the EMWAC (European Microsoft Windows NT Academic Consortium) HTTP Server for Windows NT offers an alternative. This server installs itself as a "service process," the NT jargon for a daemon, the first time you run it. You then configure it with a single dialog box in the NT control panel. It comes with readable documentation and a WAIS (Wide Area Information Service) text-search engine.

The EMWAC HTTP server has drawbacks; it's slower than a Unix server, and it suffers from the lack of a good script language in NT. You must program the scripts in C++, using the examples provided. But it's capable of handling multiple users, and it's easy to install and use. You can download it from EMWAC at ftp://emwac.ed.ac.uk/pub/https/hsi386.zip.

A new breed of commercial servers is designed to control access and extract payment from customers. Commercial servers cost from $1000 to $25,000, but they feature easy installation, technical support, authentication, and encryption. *Authentication* is used to verify the identity of a customer for confidentiality or billing purposes. *Encryption* is used to guarantee the security of information, such as bank account and credit card numbers, and to provide digital signatures on agreements, such as order forms. As of this writing, Netscape Communications (Mountain View, CA, http://home.mcom.com) and Enterprise Integration Technologies (Menlo Park, CA, http://www.eit.com) have announced their intention to offer these features. However, the authentication and encryption features work only with matching versions of Mosaic.

Step 6: Design your Web service. After you get your server up and running, the task of designing your literature begins. Web documents are formatted using HTML (Hypertext Markup Language). Fortunately, HTML consists of a small

capability:

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Illustration by Ajin As seen in Business Week International, February 15, 1993 Issue

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One Person's Internet Business

PAULINA BORSOOK

Eric Thiese, principal of Liberty Hill Cyberwerks (San Francisco, CA), provides Internet training and consulting services. He helps businesses obtain basic Internet E-mail services and set up WWW (World Wide Web) servers. These WWW servers are physically located at Thiese's home office.

For his main machine, he uses a custom 66-MHz 486 computer running on BSDi that's built to his specifications for longevity. His setup also includes a T1 line, a Livingston router, a Tielink CSU/DSU (channel service unit/data service unit), and the Free Software Foundation's version of Gopher. In addition, he has three other machines, including a 386 that he uses to run Liberty Hill.

As his business grows, Thiese may reach out to local HTML (Hypertext Markup Language) writers and contractors, but because he has more than a few dozen clients, his sole proprietorship would be stretched beyond its resources if he did so. Thiese believes that the opportunity for a business like his may exist for only a couple more years. But for now, there is a market window that he can take advantage of since "most of the [Internet] tools are on Unix, and there's a lot that people don't know." This may change as easier-to-use Internet tools for Macs and Windows-based machines become available.

"There's money to be made on what people do not know."

—Eric Theise

There's another reason why his business is thriving, however: Large computer and communications corporations and technology-consulting firms have not yet targeted small businesses wanting a storefront Internet presence as a market. But this situation may also change as the commercialization of the Internet grows.

Or it may turn out that most businesses won't need E-mail or WWW sites. Thiese says that since it's easy to tell when a node is being accessed, it's also easy to tell if an Internet node is providing a customer's clients with the information or access that they want. And if a node isn't being accessed often, he and his customers can then figure out ways to make the site more helpful, more entertaining, or more interactive.

Paulina Borsook is a San Francisco–based writer who has written previously for BYTE about security issues. You can contact her on the Internet at loris@well.sf.ca.us or on BIX c/o "editors."

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number of keywords and is much simpler to use than it might sound. You can get a tutorial from http://www.ncsa.uiuc.edu/General/Internet/HTMLPrimer.html.

You'll want to use graphics in your documents to appear polished and larger than life. Get a good computer drawing package and a video frame grabber for taking pictures. If you decide to work with an independent designer, make sure that he or she can produce digital pictures.

An HTTP server does just two things: Send files out to a client and call scripts and programs on your server computer. For instance, after a client fills out a form, a script can take the information and store it in a file or a database. The script might also generate a fax or E-mail response.

Sophisticated publishers use scripts to generate documents on-the-fly from databases. My company has used this technique to publish large financial databases with millions of potential pages. Other firms use database scripts to look up and display catalog information. You can find some sample database publishing applications and tools at http://www.ncsa.uiuc.edu/demoweb/demo.html.

Step 7: Close the loop with electronic commerce. Big institutions are betting that electronic commerce will soon energize the Internet. Electronic commerce includes pay-per-view publishing; industrial EDI (Electronic Data Interchange) for ordering and billing; home banking; trading and betting; and on-line shopping. You need no real estate and only minimal amounts of labor to participate in electronic commerce; it thus has the potential to benefit small businesses by lowering fixed costs.

Several payment mechanisms are competing to finance on-line shopping and pay-per-view publishing on the Internet. In the simplest version, a customer fills in a credit card number on an order form to complete a non-face-to-face transaction, which is similar to placing an order over the telephone. Encrypted Mosaic browsers and servers are designed to support such transactions by making it safer to send credit card numbers over public networks.

A more sophisticated mechanism uses a payment server maintained by a bank where the customer has an account. The customer uses encryption software, along with a public-key certificate, to digitally sign a payment authorization. The vendor receiving this authorization then redeems it for money with the payment server. This system is more secure than others because vendors don't obtain customers' credit card numbers. It can also support the smaller, more numerous transactions that would be required for pay-per-view.

A more radical scheme is the aforementioned concept of digital cash, which is currently being offered by DigiCash (Palo Alto, CA, and Amsterdam, http://www.digicash.nl). Digital cash consists of anonymous electronic tokens that can be exchanged via encryption software and redeemed for real cash at participating banks. In practice, digital cash is similar to the payment-server mechanism, since you need to redeem each token at a payment server to check its continued validity.

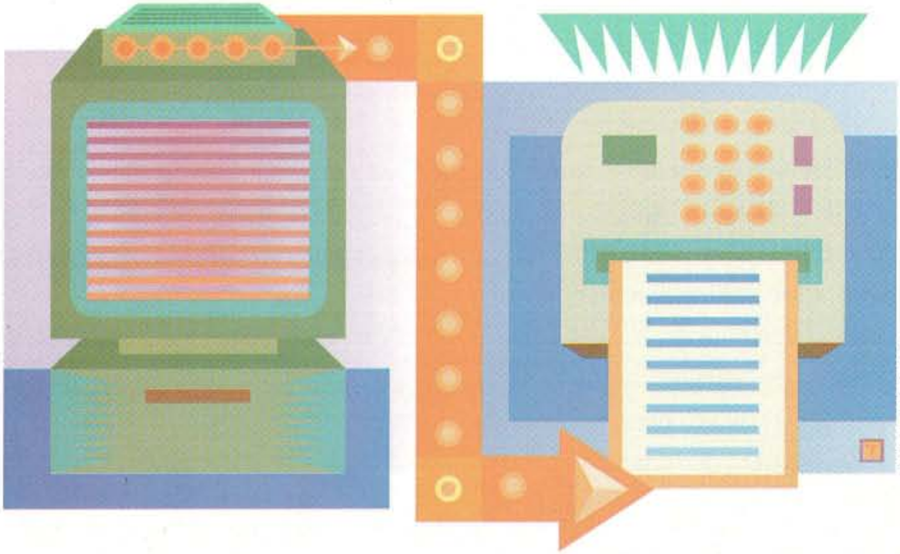
Step 7: Promote your site. Just having a server isn't enough; you want people to notice it. One way to invite attention to your server is to put some useful, free information on it and then announce it in a few selected Usenet newsgroups that are relevant to your business.

Post an announcement to the NCSA what's new page, whats-new@ncsa.uiuc.edu. Get your suppliers and customers to link your home page to theirs. Be sure to put your E-mail address and Web URL on all your business cards and literature. Then stake your claim. ■

Andrew Singleton (Dublin, NH) is president of Money.Com, a provider of payment services and professional financial information services on the Internet. You can contact him on the Internet at asingleton@money.com or on BIX c/o "editors."

Curing the Windows Fax Blues

STAN MIASTKOWSKI



JEAN TUTTLE © 1995

Faxes are an essential part of business communications. In fact, they've become even more prevalent as modem manufacturers have widely incorporated fax capabilities. There's a simple reason for this: All the chip sets at the heart of today's modems incorporate fax features.

The advantages of computer-based faxing over stand-alone fax machines are numerous. You can fax high-quality output directly from your applications without having to go through the extra steps of printing documents and going to a fax machine. On the receiving side, there's no need to deal with curly and inconvenient thermal fax paper. You can discard junk faxes without having to print them and print high-quality copies of the faxes you want to keep. Most important for small businesses, fax modems are by far the cheapest way to obtain fax capability.

But at the same time, the promises of fax modems are often just that: promises. Unfortunately, there's another scenario that's becoming all too common. You've just installed a fax modem and software. You click on an icon, get your fax all ready to go, and send it. Then...nothing. If you're lucky, you might hear a click from your fax modem or perhaps see a "helpful" error message, such as Event Error. Even worse, the fax modem hardware and software that have been working fine for months may suddenly become obstinate and cranky.

Certainly, many users have few or no problems. However, both fax modem makers and fax software developers grudgingly admit that their technical-support lines field numerous calls from irate or frustrated users.

Fast Fax Facts

Although fax machines and fax modems use sophisticated methods for setting up calls (see the text box "The Anatomy of a Fax Call" on page 134), faxes are essentially simple unidirectional, nonprotocol data transmissions that don't use error correction. The type of information that's transferred in a fax transmission appears, at first blush, laughingly simple when compared to the ASCII and binary data that modems regularly handle.

Yet, like all data transmissions, faxes require very critical timing. Cobbling old-fashioned fax technology into the modern world of resource-hungry, multitasking operating systems can cause endless problems. But there are solutions (see the text box "Solving Fax Modem Problems" on page 138).

Toronto-based Delrina is the maker of the market-leading WinFax Pro for Windows software as well as FaxPro for Mac. According to John Visca, Delrina's technical-support team leader, 75 percent of Delrina's technical-support calls are for hardware configuration problems. Nearly all of them are PC-related. Macs handle peripheral connections more intelligently, and they are also much less prone to software-timing problems.

You can get problem-free productivity by using a fax modem in your Windows PC. Here's how.

The IBM PC standard has saddled users with some maddening hardware limitations. When it comes to the serial-port connections that fax modems use, you're usually limited to the standard installed settings of COM1 (IRQ [interrupt request] 4, base address 3F8h) and COM2 (IRQ 3, base address 2F8h). Optionally, you can also configure COM3 and COM4 using different base addresses, although the fact that they also use the default IRQ 4 and IRQ 3 interrupts is another cause of compatibility problems.

The UART Dilemma

At first glance, it seems that external fax modems rather than internal models would eliminate serial-port configuration problems. If, for example, your PC is equipped with the usual array of two serial ports, it's a simple matter of plugging a serial cable from your fax modem to a free serial port. But, especially with older PCs, you're likely to run into problems with externally connected serial-port hardware.

The heart of a serial port, whether in an add-in card or built into the motherboard, is an integrated circuit called a UART (universal asynchronous receiver/transmitter). There is one for each serial port. The UARTs used in the original PC format were designed to match the common data transfer speeds of the era, a leisurely 300 bps, not today's fax transfer rates of 9600 bps and 14.4 Kbps (not to mention the increasingly common V.Fast speed of 28.8 Kbps). The 8250 and 16450 UARTs still commonly found in many PC serial ports have no internal buffer for smoothing data transfer. Without this buffering, your PC's processor and the communications software must work harder to pick up the slack.

What's needed for contemporary communications is the more capable 16550 UART, which has a built-in 16-byte buffer that smoothes data flow and eliminates many intermittent and hard-to-locate problems with both faxes and data communications. Unfortunately, the realities of the hardware business make 16550 UARTs difficult to find in even many of the latest PCs. In single-unit quantities, old-style 16450 UARTS cost about $5; 16550 UARTs cost about $20. In the quantities that computer makers use, individual costs

The Anatomy of a Fax Call

Whether there's a fax modem or fax machine on either side (or both sides) of the line, all fax calls go through the same five-step process:

1. Connection: The calling fax uses the standard V.21 fax protocol to establish a physical connection with the receiving fax at 300 bps. The receiving station sends a STID (station ID) to the calling fax.

2. Phasing and training: Still at 300 bps, the calling station sends a single HDLC (high-level data link control) frame to the receiving station. During a 200-millisecond "window," both sides negotiate a maximum sending speed (depending on line conditions). The calling station then sends null characters to the receiving station at the negotiated speed. If the receiving station receives characters, it sends confirmation and control is returned to the calling station.

3. Unidirectional transfer: The calling station sends data to the receiving station in a one-direction, nonprotocol transfer (no error correction). At the end of each page, the calling station sends an EOM (end of message) and the speed returns to 300 bps. If no further pages are to be sent, the calling station goes to step 5. If more pages are to be sent, the calling station goes to step 4.

4. Negotiation: Before another page is sent, both of the stations go through the same negotiation as found in step 2 to detect if the line conditions have changed.

5. Disconnect: At the end of the transfer, both systems disconnect from the telephone line.

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are much lower, but the cost savings of using old UARTs goes directly to the bottom line.

It's easy to find out what type of UART your PC uses. Just run MSD.EXE (Microsoft System Diagnostics), versions of which come with both Windows and MS-DOS 6.x. The COM Ports menu selection shows you what UART your serial ports are using. If they don't use the 16550, you have several choices. If your serial ports are on an add-in I/O board, the simplest solution is to replace the board. Most board makers (e.g., Boca Research) have 16550 UART boards, but they're about twice the price of 16450-based boards. Expect to pay $50 to $65 (street price) for a 16550-based dual-serial, single-parallel board.

More complicated and expensive I/O-card solutions are available from other companies. Sophisticated serial boards like the Hayes ESP Communications Accelerator 2.0 and DigiBoard's PC/2e have dedicated processors and huge buffers that pull the chore of smoothing data flow and timing away from the PC hardware. They're more than a little overkill for standard fax modem use. For the coming generations of ultrahigh-speed modems and applications like remote LAN access, however, they fill a genuine need.

By far the easiest way to update your UARTs is to buy an internal fax modem. Almost without exception, today's internal fax modems use 16550 UARTs for maximum performance. However, incorrect internal fax modem installations are a major cause of fax problems. If your PC has a pair of internal serial ports, you'll need to disable one of them before installing your internal fax modem.

Two serial ports attempting to use the same interrupt invariably cause major problems. That normally means changing jumpers on an add-in board or on your motherboard, although some newer PCs, including those from Dell and Gateway 2000, with on-motherboard serial ports have the "smarts" to detect if an internal fax modem is installed and disable conflicting ports.

The Software Side

Even if your fax modem is correctly installed, your serial ports use 16550 UARTs, and your cables and phone line are correctly installed, you're not out of the woods. Potential problems still exist with fax modem calls. Both fax modem makers and fax software developers are quick to point to one of the biggest problems with computerized fax communications: Microsoft

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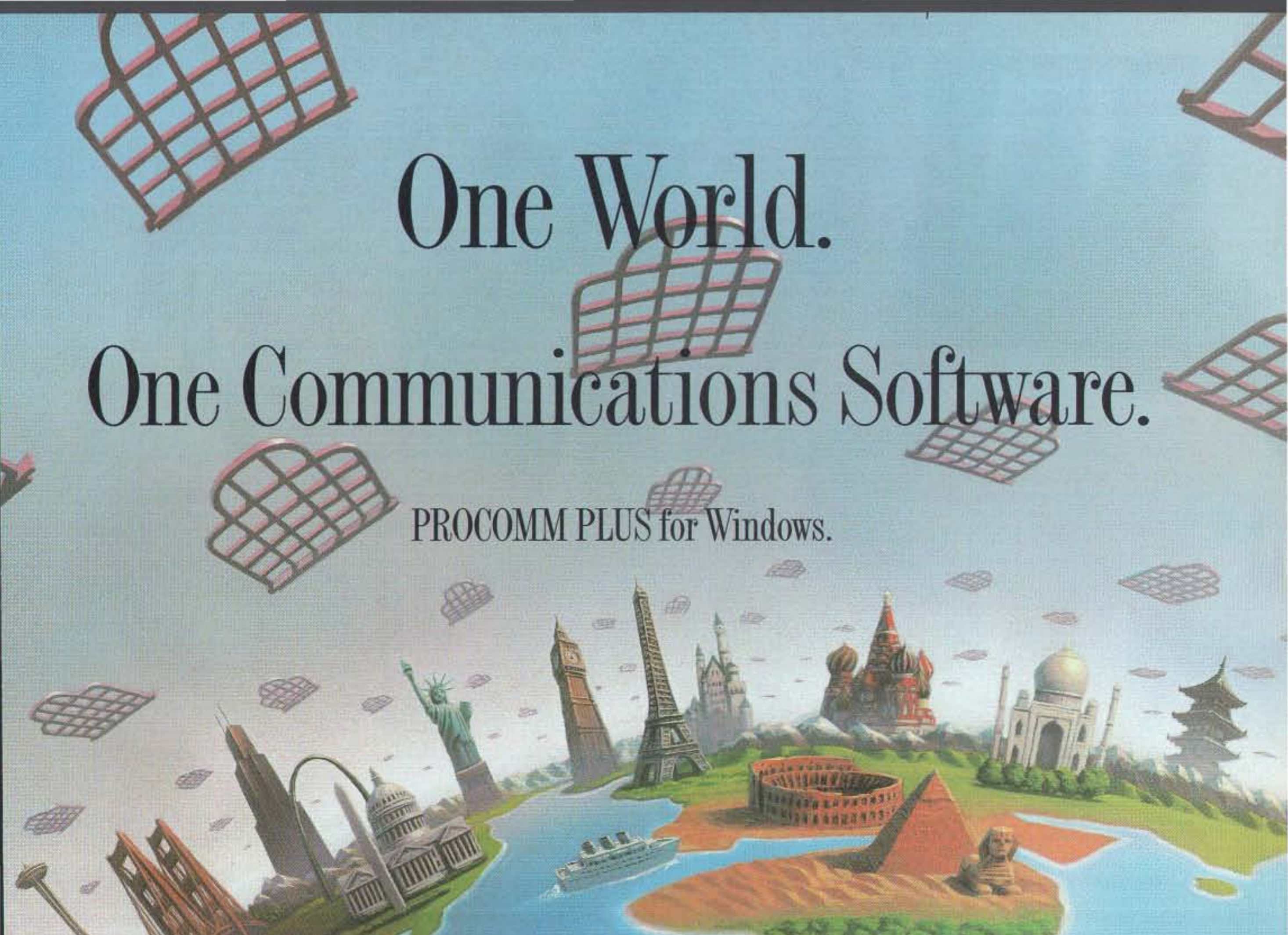

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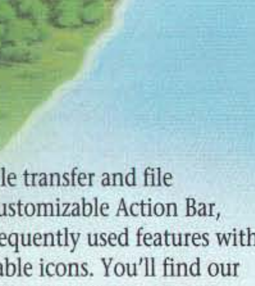

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Solving Fax Modem Problems

If your fax software and fax modem just aren't talking to each other, or fax sending or receiving has suddenly become unreliable, there are a number of possible problems and solutions:

- Is the (external) fax modem plugged in (AC and phone line), turned on, and connected to the correct serial port?
- Is the (internal) fax modem attempting to use an IRQ (interrupt request) that another serial port is already using?

If your fax modem software is running from Windows and fax communications (or the quality of received faxes) are unreliable, check the following:

- Does your internal fax modem or serial-port I/O board use a 16550 UART (universal asynchronous receiver/transmitter)? Use MSD.EXE to find out.
- Are you using Microsoft's old Windows 3.1 COMM.DRV? If so, update the driver to version 3.11, or use the driver supplied with your fax software. You can also buy a third-party driver, such as TurboCommander.
- Is your available DOS memory (before starting Windows) low? Disable as many TSR programs (from AUTOEXEC.BAT) as possible. Also remove any unneeded TSRs from the `LOAD=` line of Windows' SYSTEM.INI file. Screen savers and virus checkers are particular culprits.
- Make sure Windows is using a permanent swap file and it's at least the recommended size. (From Windows' Main group, enter the Control Panel, choose the 386 Enhanced icon, and click on the Virtual Memory button.)
- Delete any .TMP files created by Windows and Windows applications. These are usually deleted automatically. (To find where .TMP files are stored, type `SET` at a DOS prompt and make note of the directory that `TEMP=` points to. Change to that directory and delete all .TMP files in it.)
- Run CHKDSK /F from DOS (SCANDISK from MS-DOS 6.22) to check for disk errors and repair them.
- Run DEFRAG (from MS-DOS 6 or higher) or a third-party disk defragmenter to optimize your hard disk.
- If Windows fax performance is still flaky, try adding the following lines to the `[386Enh]` section of Windows' SYSTEM.INI file:

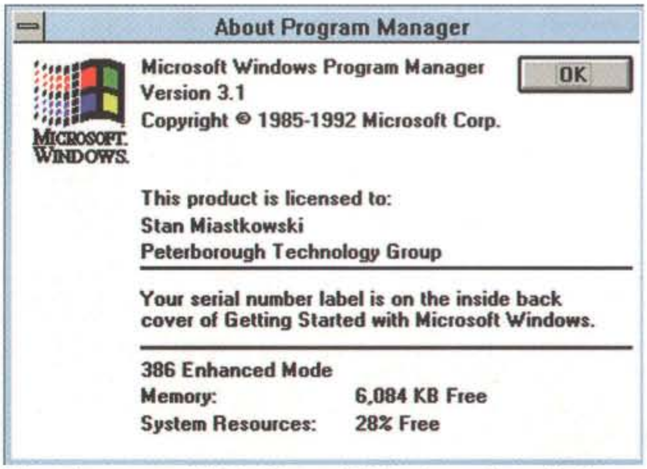
```
COMBOOSTTIME=30
COMxBUFFER=4096
```

(x is the COM port number your fax modem uses).

Windows. The demands that Windows places on system hardware are especially acute in communications, where timing parameters are critical. If your PC is a 386 or even a 486 with 4 MB or less of RAM and you use multitasking applications, at some point the system will become so bogged down that data flowing to a fax modem will slow down. This causes fax failure.

According to industry sources, one of the major causes of fax failure in PCs is too many TSR DOS programs. For example, Delrina's Visca says that virus checkers are common troublemakers. The obvious solution is to use as few TSRs as possible. But even with maximum DOS memory before starting Windows, it's still easy for Windows to reach a point where it can no longer reliably handle communications. The key measure of upcoming trouble is Windows system resources. Pull down Help and About Program Manager from the Windows desktop to see your current resources.

Even a 486/66 with 16 MB of RAM can reach a critical resource point when you multitask four to six major applications (e.g., Microsoft Office or Lotus's SmartSuite). Some add-on Windows utilities—such as Norton Utilities 8.0 or Dashboard 2.0, which Borland recently acquired from Hewlett-Packard—feature on-screen resource meters and even let you set alarms if Windows resources fall below a certain level.



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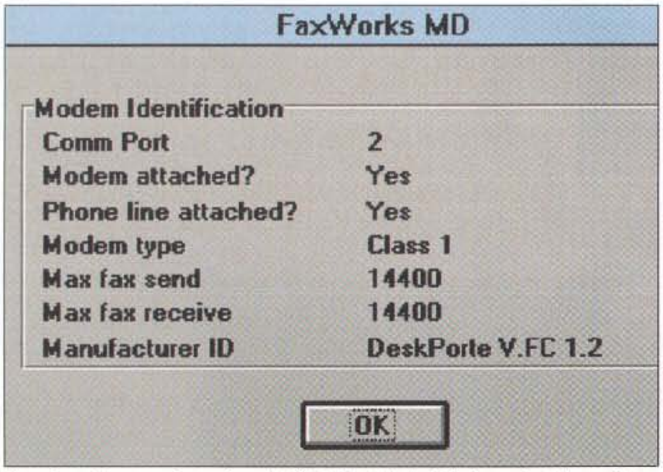
When system resources fall below 30 percent, Windows' preemptive multitasking can no longer handle the critical timing parameters needed for successful fax and data calls.



Modem Identification

Comm Port	2
Modem attached?	Yes
Phone line attached?	Yes
Modem type	Class 1
Max fax send	14400
Max fax receive	14400
Manufacturer ID	DeskPorte V.FC 1.2

Many fax software packages (e.g., FaxWorks) include built-in fax modem diagnostics that go a long way toward isolating common problems. You can easily spot simple problems, such as an improperly assigned COM port.

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COMM.DRV Horrors

Perhaps the least-known and most-common cause of Windows communications problems with both data and fax transfers is the infamous Windows communications driver (COMM. DRV). The driver shipped with Windows 3.1 works fine for low-speed communications and most of the time for 9600-bps fax calls. However, because it lacks built-in support for the 16550 UART, it's a common troublemaker with contemporary fax modems.

Microsoft has updated the driver and added COMMDLG.DLL (a DLL with 16550 support) to Windows 3.11 and Windows for Workgroups. To see what version of Windows you're running, again pull down Help and About Program Manager from the Windows desktop. If it doesn't say version 3.11, you've located a potential cause of problems. An archive to update Windows 3.1 to 3.11 is available free of charge (except for connection charges) from CompuServe (GO MSL [Microsoft Software Library], file WW0981.EXE), the Microsoft Download Service ((206) 936-6735), or BIX (WW0981.EXE in the windows/listings area).

Some Windows fax packages automatically install their own drivers. For example, Delrina's WinFax Pro has a driver named WFXCOMM.DRV. Also, other third-party suppliers have COMM.DRV replacements that go far beyond the capabilities of even the updated Microsoft communications driver. TurboCommander from Pacific CommWare (Ashland, OR) is a case in point. This utility replaces COMM.DRV and adds a raft of extras, including the ability for multiple devices (e.g., COM1 and COM3) to share a single interrupt without causing problems.

It's easy to get discouraged about the many things that can go wrong, but the vast majority of fax modem installations proceed with few or no problems. The end results are worth it. And the future is brightening for Windows users. Windows 95, with its Plug and Play support, promises greater support for all types of communications. Nearly painless fax modem installation and use are distinct possibilities for the future. ■

Stan Miastkowski is a BYTE consulting editor who's been writing about communications and networking technology for over 16 years. He's coauthor of Windows for Workgroups Bible *(Addison-Wesley, 1993). You can contact him on the Internet or BIX at stanm@bix.com or on MCI Mail at 530-9979.*

URGENT—YOUR INPUT NEEDED

On: OBJECTS ACROSS THE ENTERPRISE

Dear Reader:

To improve BYTE's coverage of technology in the State of the Art section, we'd like to get *your* feedback about what topics, areas, and products we should be considering, and in what ways. Later this year, we're planning to cover how object-oriented technology is being used in the real world, in large organizations and enterprise-wide applications. So we need to know what you'd like to see in this area, what products and services should be available, and please include tips on people we should be talking to—users, vendors, researchers—you tell us! Let us know what you're doing with object technology in your organization—how you're using it, why you chose this path, and the problems and benefits you've encountered.

Also, we're using a new method to capture your comments and suggestions so that we can use them more easily in the future, not just as a one-shot item. To let us know what you think, please use the following as a template to send us, via E-mail, an ASCII text file with your comments. Please be sure to include the `<FIELDNAMES>` with their angle brackets, followed by your information and comments. And thanks very much for your help.

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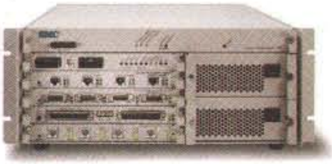

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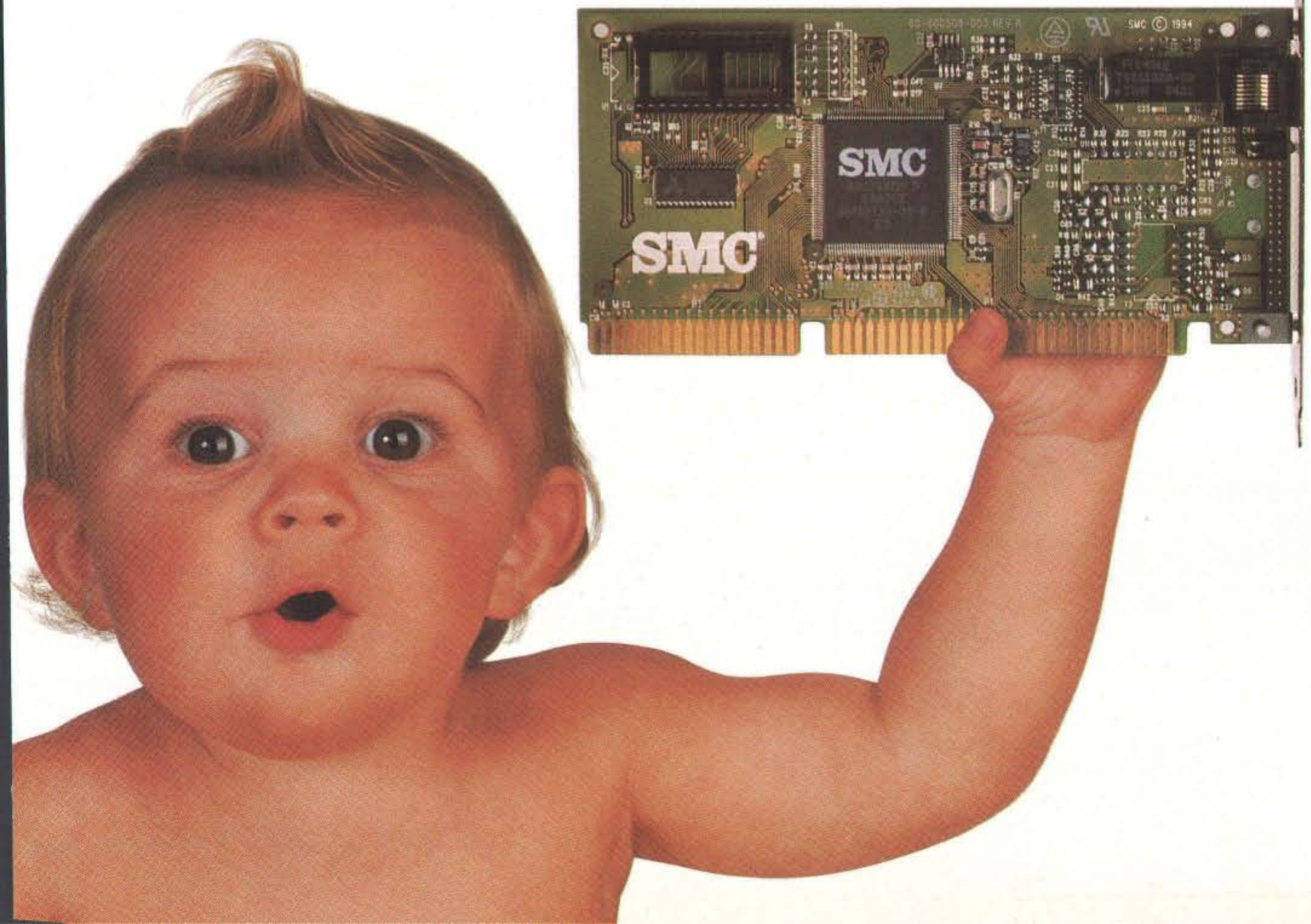

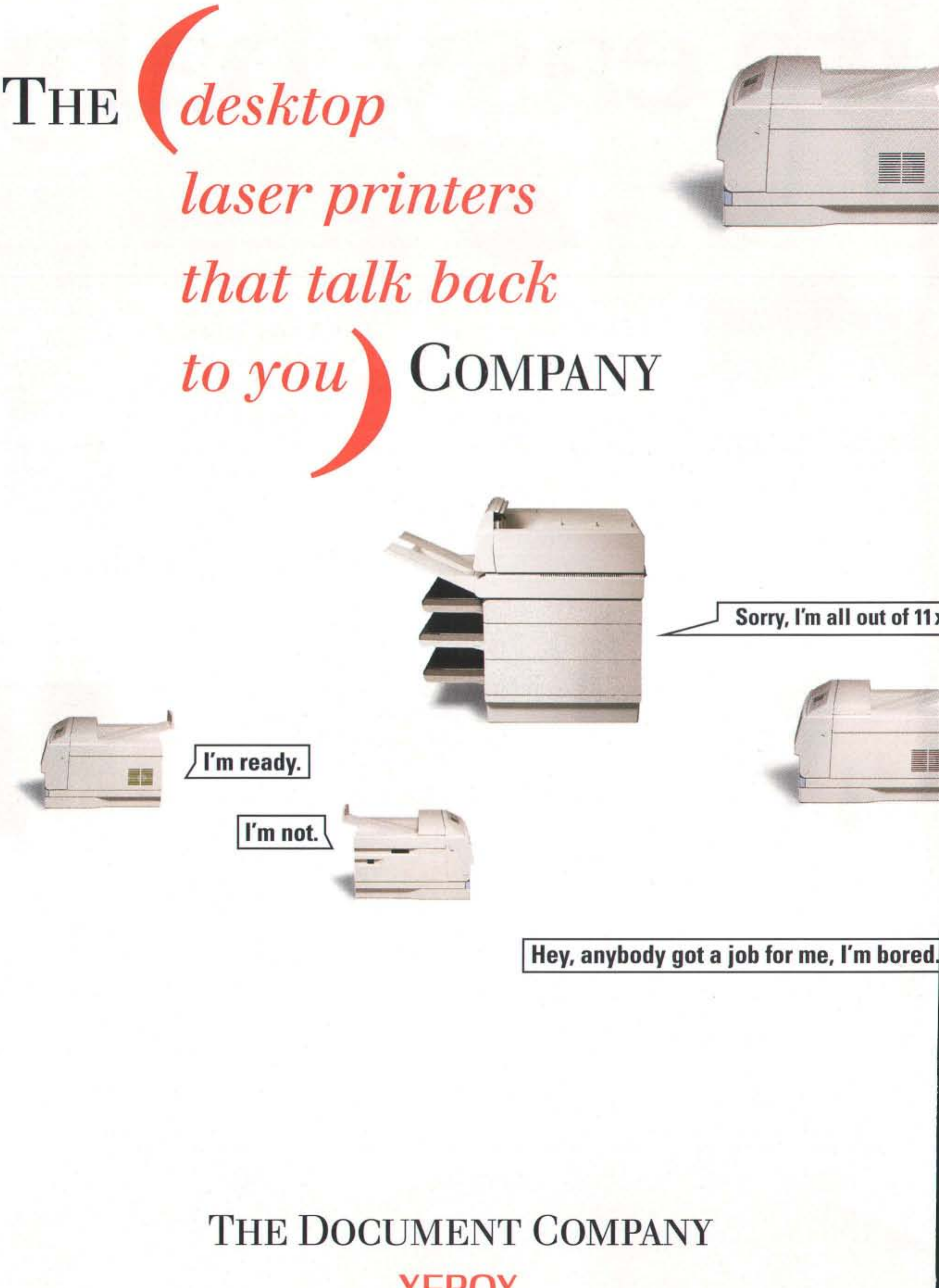
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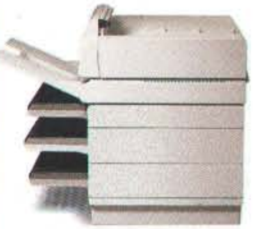

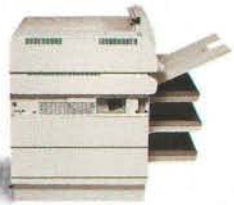

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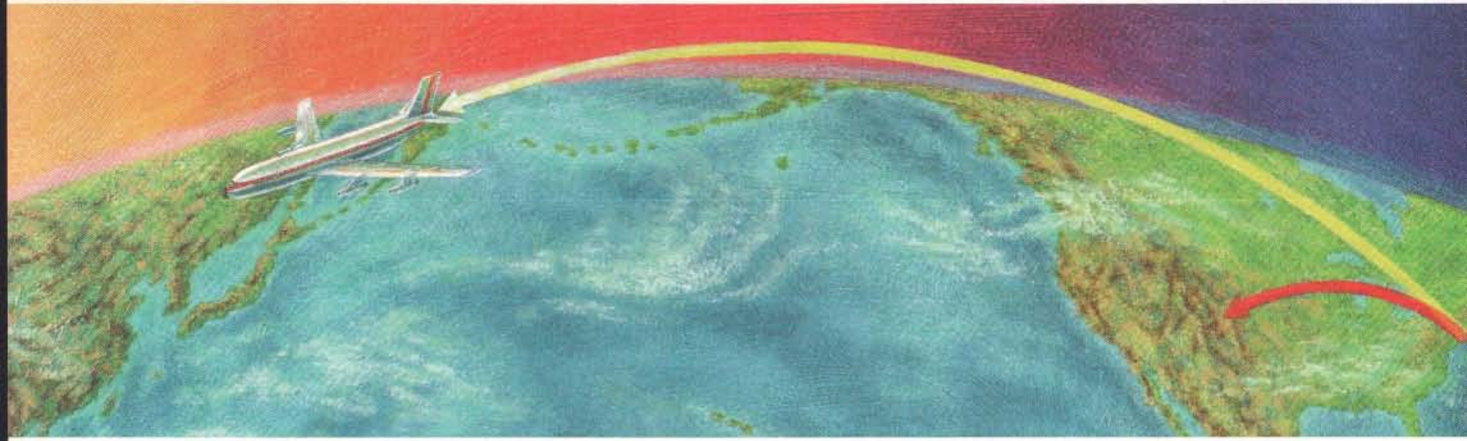

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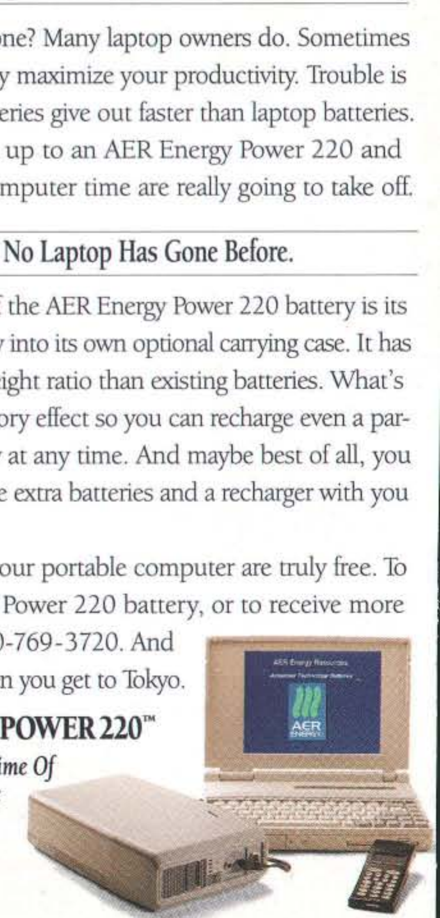

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Circle 267 on Inquiry Card (RESELLERS: 268).

Doing It All on One Line

ANDY REINHARDT

JEAN TUTTLE © 1995

In a small office, where you're trying to keep costs to a minimum, having to install two or more separate phone lines for voice, data, and fax calls seems wasteful. A new class of multimode modems solves this problem with an added benefit: Not only can you share a single line among multiple uses, but you can do so *concurrently*. The only other way to accomplish the same thing is via ISDN, which still isn't available in many areas and costs more than analog phone service.

The most obvious use for multimode modems is conferencing, where two or more users view and discuss documents at the same time. But there are dozens of other potential uses, including visual voice-response systems and information access, product support, show-and-tell remote presentations, multimedia messaging, and business-card exchange. Many of these applications are especially tempting to mobile users, telecommuters, and owners of home-based businesses.

The simplest, least expensive, and likely most widely installed solution will be a new class of switching modems built using the VoiceView technology from Radish Communications Systems (Boulder, CO). VoiceView runs across conventional phone lines and equipment, sharing a line, for instance, between a phone call and a file transfer by switching quickly from voice mode to data mode and back again. Radish has licensed VoiceView to major modem manufacturers (representing roughly 85 percent of the market, Radish says) and software companies, including Microsoft, in a bid to establish it as the baseline standard. The cost of adding VoiceView support to modem firmware is so low (Radish charges only a one-time fee, not a royalty) that analyst Harry Newton, president of Computer Telephony Expo (New York, NY) expects 60 to 70 percent of all new modems sold by the end of 1995 to include support for mode switching.

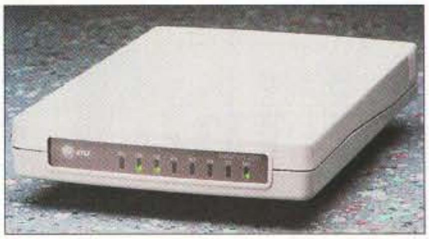
Radish isn't the only game in town, however. AT&T Paradyne (Largo, FL) and Multi-Tech (Mounds View, MN) make modems that let you combine voice and data on a single line *simultaneously*, rather than switching between the two modes. (See the photo on page 146.) These cost more money—on the order of $500—and they use proprietary (and different) modulation schemes, which means that you have to have the same modem on both sides of the line. But through an agreement with Radish, AT&T will also support VoiceView, so if an AT&T simultaneous voice/data modem calls a Radish-type modem, the AT&T device can "fall back" into a switching mode.

Multimode modems cut phone bills, facilitate document conferencing, and enable "visual" interactive voice response

Another option comes from Spectrum Signal Processing (Burnaby, BC), which specializes in products based on DSPs (digital signal processors). Spectrum has already staked out a position in computer/telephony boards (the Envoy II fax/modem) and multimedia (SoundChoice32) and has recently introduced the OfficeF/X, a fax/modem/sound card with software for unified inbox, Internet mail, and call management.

In early 1995, Spectrum plans to go a step further, adding support for simultaneous voice and data, first on a 14.4-Kbps "soft" modem and later in a 28.8-Kbps implementation. For the time being, Spectrum's solution will be proprietary, but the company hopes to include Radish-compatible switching and is also working with other players on standards for simultaneous voice and data.

In a sense, all these schemes are in a race against time, because what they provide for customers can be done better and faster by ISDN digital telephony. ISDN's 2B+D basic rate provides two 64-Kbps voice/data channels and a 16-Kbps data channel, for a net bandwidth of more than four times that of a V.34 modem. But Radish, AT&T Paradyne, Spectrum, and others are counting on the current conventional wisdom that says it will be years before digital telephony is ubiquitous—not just ISDN service but



The AT&T DataPort 2001 Multimedia Communicator modem carries both digitized voice and computer data simultaneously over the same carrier, allowing you to talk and swap documents with somebody on the other end of the phone at the same time. The technology is proprietary, so you need at least two DataPort 2001s, but AT&T has agreed to support the Radish Communications VoiceView modem-switching protocol.

also compatible phones and other devices on customer premises.

The Baseline

By positioning its technology as the least common denominator, Radish hopes that users will soon be able to assume the presence of VoiceView modems on the other end of the line. To that end, Microsoft plans to build support for VoiceView into Windows 95. Developers will start to count on an installed base and write new programs that take advantage of multimode communications. "VoiceView is an arbitrator," says Paul Davoust, vice president of marketing at Radish. "It's the fundamental glue in computer-telephony integration."

Whether switched or simultaneous, the basic benefit of multimode modems is that you can talk *and* exchange data during a single phone call. You could discuss a project with a colleague, transfer a spreadsheet file, view the spreadsheet together while discussing its numbers, fax over a mock-up for the packaging design, and so on, all while using one live phone line.

Document conferencing programs from Intel (ProShare), Crosswise (Face to Face), Future Labs (TalkShow), and DataBeam (FarSite) are obvious candidates for multimode modems, because by definition they involve two users discussing and viewing data at the same time. None of these packages now supports voice directly; to the contrary, they require that you use two phone lines, one for the voice call and another for the modem to exchange data. Moreover, the two calls must be placed separately, and you accrue twice the service charges. By contrast, riding on top of a multimode modem lets you initiate a single call and share the service cost among uses. Most document conferencing programs will be able to support multimode modems with little or no modification.

One conferencing package, ShareVision PC3000 from Creative Labs (Milpitas, CA), was designed from the very beginning to support simultaneous audio, video, and data communication. In fact, the bundled hardware and software package includes a proprietary 28.8-Kbps multimode modem that compresses audio and video (using a scheme called Vector Adaptive Transfer Processing) and multiplexes it with data across a single line. Creative has not commented on whether it plans to move toward a standards-based modem.

Trade-Offs

The switched and simultaneous solutions have opposing strengths and weaknesses. Radish boasts of its ability to work transparently on nearly any phone infrastructure (i.e., analog or digital PBXes, Centrex, and so on). But with switching modems, conversation ceases during data transfers. The duration of the gaps in speech depends on the size of the file transfer or fax. However, both voice and data communication occur at their normal rates: standard-quality audio and 9600-bps or faster (depending on the modem) data.

The AT&T and Multi-Tech modems share bandwidth among uses; this means that conversation by itself happens at a normal rate, but when you talk and exchange data at the same time, data transfer occurs at a maximum of 4800 bps and speech quality is degraded. The unusual modulation schemes used in these devices can also pose problems when running over certain digital phone switches or IVR (interactive voice response) systems.

The quality of Spectrum's MWave-based solution depends on the underlying soft modem. In a 14.4-Kbps version, 13 Kbps is allotted to voice (8-bit digitized voice, sampled at 16 KHz and compressed using GSM (Global Standard for Mobile communications [the pan-European digital cellular standard]) encoding, leaving only 1400 bps for a trickle of data communication during conversation. But during minute breaks in speech, data speed surges to 14.4 Kbps. In the planned 28.8-Kbps product, voice traffic will stay at 13 Kbps, and data speeds will vary from roughly 15.8 to 28.8 Kbps. Short of ISDN, this will be the fastest way to do simultaneous voice and data. The OfficeF/X board lists for $349, so the street price for the enhanced version probably won't be much higher.

Smorgasbord

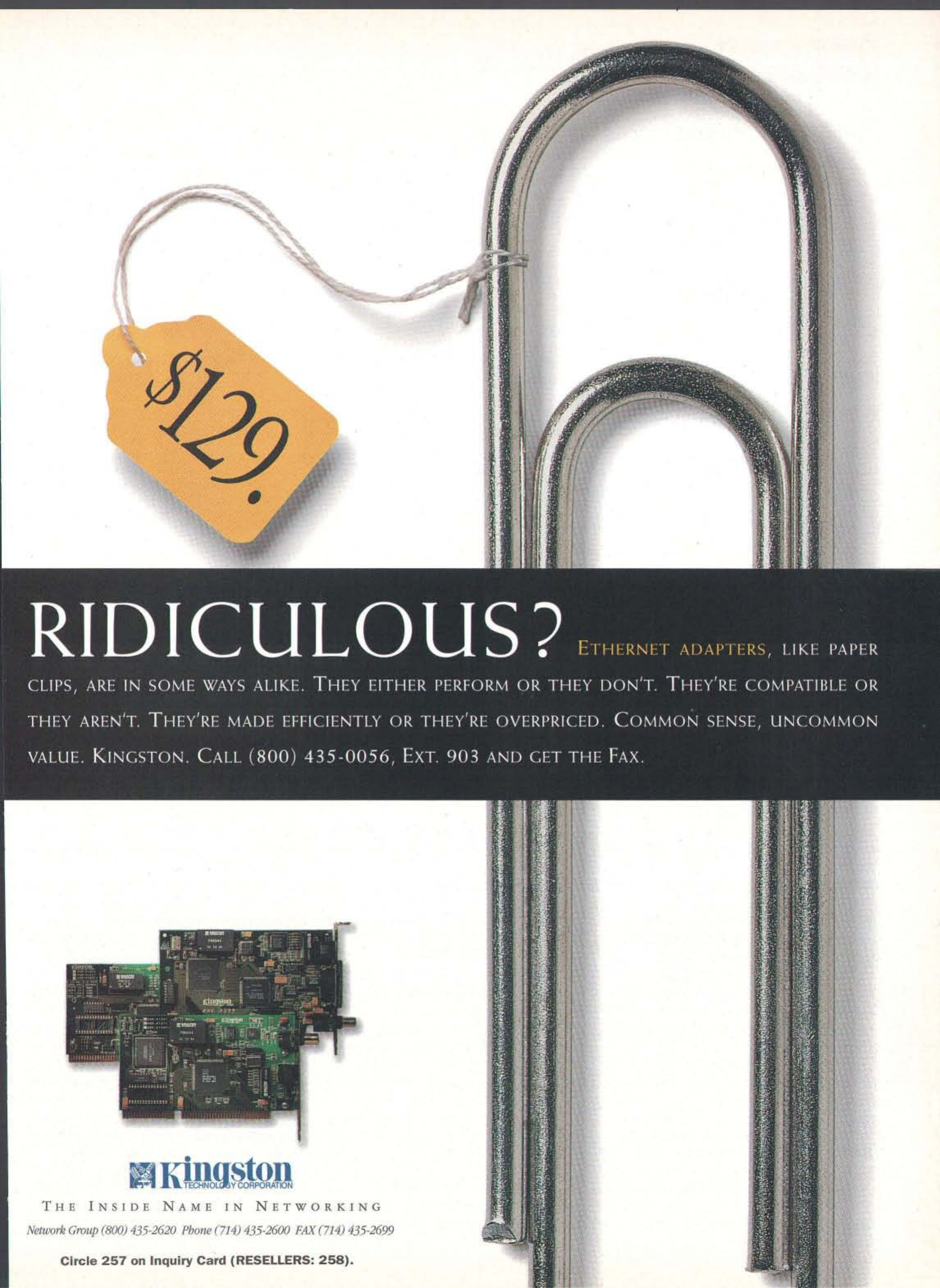
Most people are so accustomed to using a phone while working on their PCs that it never occurs to them how the two devices could be integrated. Aside from file transfer and document conferencing, multimode modems permit a variety of remote-access applications.

For instance, if you had a caller I.D. service (with or without the capability to associate incoming numbers with entries in a database) and a multimode modem fronting your voice-mail system, you could implement a visual inbox that would let you call your voice mail from a PC (locally or from the road), see the numbers (or names) of the people who had called you, and select in any order the messages you wanted to hear. Or, if you implemented a unified "multimedia" inbox, you could make a single call to a message server that would relay your voice mail, E-mail, and faxes at one fell swoop or would let you receive multimedia messages containing both voice and images.

Voice and data together will facilitate remote presentations, in which you talk somebody through a Harvard Graphics slide show, show someone real estate listings with maps and photos, or view and discuss a medical image. It could also be a boon for customer support, because a technician could, during a single call, talk to a user, perform remote diagnostics, assume remote control of a troubled system, and capture files and screens. When the presentation or support call is finished, the participants could exchange business cards in the background by clicking on an

APPLICATIONS FOR MULTIMODE MODEMS

- **Document conferencing**
- **File transfer or fax during conversation**
- **Remote presentations**
- **Product support with remote access**
- **Visual voice mail**
- **Multimedia messaging**
- **Enhanced voice-response systems**



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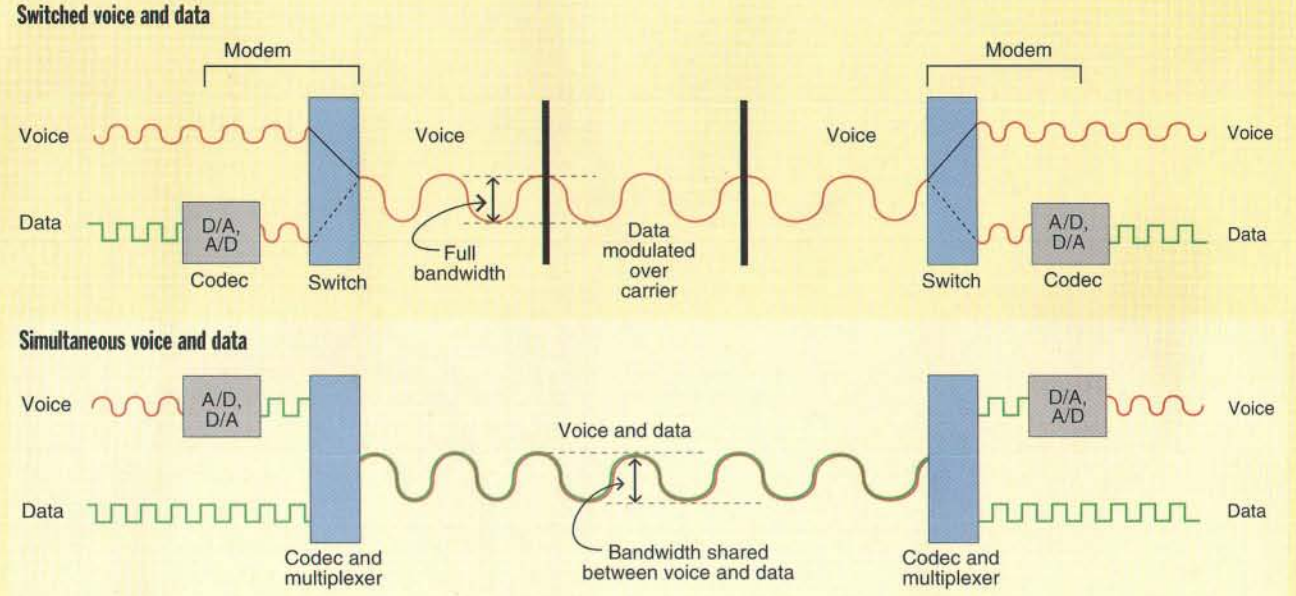
Switched vs. Simultaneous Voice and Data Transmission



Two new types of modems let you combine voice and data on a single line. Switched devices modulate data over a carrier and then alternate the full modem bandwidth between that signal and a normal voice channel. Simultaneous devices digitize voice and merge it with a data signal and then modulate the synthesized bit stream over a single carrier, in effect sharing the modem's bandwidth between the two sources. Both types typically come with software that supports file transfer during voice phone calls, and many include (or support) whiteboarding packages for sharing and marking up documents while discussing them.

icon (this would rely, of course, on the emergence of a standard for representing electronic cards).

Perhaps the greatest and most underappreciated application for multimode modems is as an enhancement to traditional IVR systems, for applications ranging from banking to shopping to order entry. Given that multimode modems can "query" the capabilities of devices on the other end of the line, information-services providers can set up their IVR systems to be audio-only if a caller just has a phone or to switch into a visual mode if a caller is using a multimode modem. In the latter case, service providers can enrich their offerings with text, graphics, and images, as well as provide customers with visual confirmation of transactions. Users will be able to select options visually, instead of having to listen to long lists of spoken menu choices.

Davoust argues that supporting textual and graphical interfaces via conventional phone lines, using a standardized protocol, will let service providers differentiate themselves from their competition. "This will make it possible for people to get value-added phone services from call centers," he says. Thus, a customer with a multimode modem, dialing into a ticket agency, might be able to choose a seat visually, whereas a traditional voice customer would have to rely on the luck of the draw. Radish is so convinced of the business opportunity for interactive "service applications" such as these that it believes the "person-to-provider" market will precede and initially outpace that for "person-to-person" mixed-mode communications.

Radish is selling tools for developing Unix- and OS/2-based VoiceView servers in conjunction with Dialogic, which has a 65 to 70 percent market share of call-processing boards with four or fewer ports, according to Nancy Jamison, a senior analyst with Dataquest (San Jose, CA). The pairing of Radish and Dialogic is especially promising for small businesses looking for an inexpensive way to jump into interactive merchandising and customer relations. With a single server, you could set up a purely voice-based service and, driven from the same underlying databases and menus, an interactive on-line service. A customer could then use the service visually or through voice menus, depending on the device he or she was dialing in on.

Smooth Sailing

Despite Radish's effort to establish a baseline standard, users may not be willing to settle for switching voice and data when solutions such as the Spectrum 28.8-Kbps modem arrive on the market. Barry Jinks, president of Spectrum, argues that although his firm's product is similar in concept to the simultaneous voice/data products from AT&T Paradyne and Multi-Tech, it benefits from being based on a DSP and, thus, being upgradable via software. As for Radish, Jinks contends that switching solutions aren't feasible for some applications, such as "telegaming," where two users in remote locations collaborate on a video game, because the sound and images have to be synchronized.

Spectrum, too, could enjoy only a limited window of opportunity if ISDN becomes more widely available throughout the U.S. and the world. Sharing less than 30 Kbps of bandwidth between a voice channel and simple data transfers is a reasonable solution. But as soon as you introduce multimedia data types—24-bit color, animations, digital audio, and especially video—the requirements skyrocket. Even basic-rate ISDN isn't a fat enough pipe for sending video clips from your home office to a client across the country.

Andy Reinhardt is BYTE's West Coast bureau chief. You can contact him on the Internet or BIX at areinhardt@bix.com.

Caller ID Goes to Work

GILBERT AMINE, ANNETTE RIGGIO, AND ELLIS HILL

JEAN TUTTLE © 1995

Caller-ID telephone service enables a subscriber to see a display of a caller's phone number as the telephone rings. More than 3 million subscribers currently use this telephone service in the U.S. and Canada, primarily for its call screening and security benefits. But thousands of small-business users, ranging from pizza delivery companies to work-at-home professionals, use caller ID as well.

Business applications often require the use of a personal computer and effective integration of caller-ID information with existing software. In fact, many believe that the caller-ID-to-PC linkup is at the heart of computer-telephone integration. When you properly integrate caller-ID service with your business software, new and exciting uses for this technology emerge. For example, your software might automatically retrieve information on the calling customer or supplier, which increases productivity and makes you appear more professional (see the text box "Vodavi Keys Into Caller ID Business Applications" on page 152).

In one case, a pizza operator in the Chicago suburbs cut the company's average contact time with repeat customers from almost 2 minutes to just 19 seconds, using a PC caller-ID application from National Systems (Chicago, IL). Time is money, and the savings dropped directly to the bottom line. For this firm, caller ID also solved an age-old pizza delivery problem. Because calls are now verified, pranksters can no longer send six anchovy pizzas to an 80-year-old woman who lives alone. Customers also have benefited from caller ID, because they no longer need to repeat their name, address, directions to their location, and choice of toppings each time they call. Other service-oriented businesses could achieve similar benefits.

Customers and businesses also benefit from another caller-ID feature, call logging (see the text box "Sidekick for Windows Gets a Kick with Caller ID" on page 150). Because caller ID can be captured in a log, service professionals can "cold call" customers who phone after hours and do not leave voice messages. Prospective customers get a second opportunity to make inquiries, and businesses get the opportunity to build their customer bases. Some businesses have increased their sales by as much as 20 percent a month.

Caller ID Basics

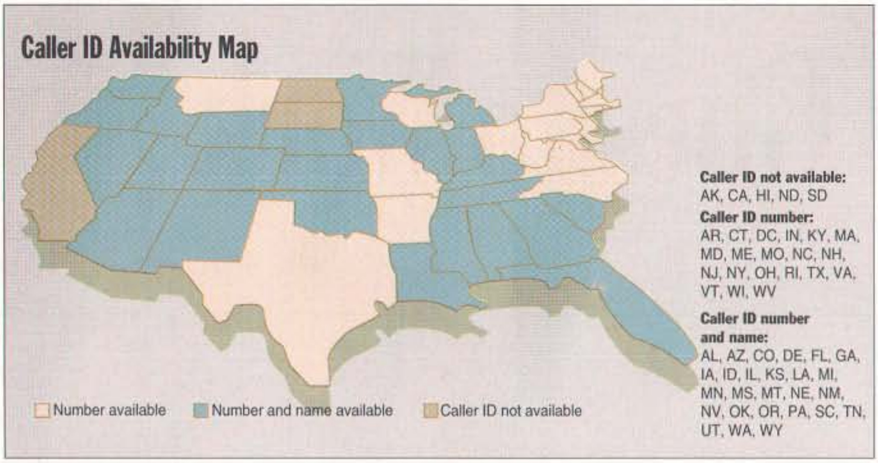
Caller ID is a member of the CLASS (custom local-area signaling services) family of telephone services offered by local telephone companies for a monthly fee. Other CLASS services include call return, repeat dialing, call rejection, call trace, priority ringing, and selective call forwarding. CLASS services depend on the presence of Signaling System 7, an advanced signaling protocol used to communicate between central offices.

By integrating caller ID with key business applications, you can provide better service and increase productivity

Caller-ID service was initially conceived by AT&T/Bell Laboratories in the late 1970s. Following the breakup of AT&T, BellSouth and Bell Atlantic were the first companies—in 1984 and 1987, respectively—to move forward with caller-ID field trials and deployments. Today, caller-ID service is available in parts of 45 states and in most of Canada (see the figure "Caller ID Availability Map"). Several other countries, including Australia, the U.K., France, the Netherlands, and Israel, have announced plans to deploy caller ID in 1995 or 1996.

For technical and regulatory reasons, caller ID is currently limited to identifying local numbers. Long-distance calls are usually identified as "out of area." As a result of a March 1994 ruling by the FCC, caller-ID services are expected to operate with long-distance and 800 calls by the end of April. At least one major carrier plans to offer caller ID on inbound 800 calls by February.

Another limitation of caller ID is that it does not always


Caller ID Availability Map
Caller ID not available:
AK, CA, HI, ND, SD
Caller ID number:
AR, CT, DC, IN, KY, MA, MD, ME, MO, NC, NH, NJ, NY, OH, RI, TX, VA, VT, WI, WV
Caller ID number and name:
AL, AZ, CO, DE, FL, GA, IA, ID, IL, KS, LA, MI, MN, MS, MT, NE, NM, NV, OK, OR, PA, SC, TN, UT, WA, WY
Number available
Number and name available
Caller ID not available

Despite a slow start due to concerns over privacy, caller-ID service is now available in parts of 45 states; Washington, D.C.; and Puerto Rico. With the exception of California, remaining states are expected to offer the service by the end of 1995. Basic caller-ID service displays only the number of the caller, and deluxe caller-ID service shows the caller's name and number. Monthly rates vary by state and type of service, and range from $3.50 to $10. (Map courtesy of Research First Consulting)

show the primary number of the caller's business. In many cases, it shows the number of the line from which the call is made, rather than the main billing number. This limitation is expected to disappear as more telephone companies offer caller ID deluxe, a service that includes the caller's name.

The availability of caller-ID services within a geographic area depends on a number of factors, including the type of central office serving the area and its deployment schedule. You should check with your telephone company business office about the availability of the service and the monthly rates before acquiring the necessary equipment or software to take advantage of caller ID.

In the U.S., Canada, Australia, and Israel, caller ID is transmitted as a burst of a Bell 202 FSK (Frequency Shift Key) modem signal between the first and second ringing cycles (see the figure "Caller ID Signaling and Data Format"). Therefore, you should always wait for the second ring before you pick up the receiver. Otherwise, the central office will abort and fail to retransmit the caller-ID data if you pick up too quickly.

British Telecom and several other European telephone companies will transmit a caller-ID signal before the first ring. This intelligent implementation avoids the early pickup problem. Not surprisingly, BT has shied away from Bell 202 in favor of its CCITT cousin, V.23. In practice, any Bell 202 FSK receiver worth its salt will also detect V.23. The Dutch telephone company has its own implementation of caller ID, which uses DTMF (dual-tone modulated-frequency) tones.

In the U.S. and Canada, the data-link layer of caller ID follows the Bellcore TR-TSY-000030 specification. It consists of two possible formats, the Single Message Format, which provides the calling number, and the Multiple Message Format, which provides the calling number and the customer or business name under which the number is listed. You can purchase the latest copy of the caller-ID specification for a nominal fee by calling Bellcore at (800) 521-2673 or (908) 699-5800.

Caller ID Products

- Call Editor (Windows), VIVE Synergies (Richmond Hill, Ontario, Canada): provides seamless integration to Symantec's Act for Windows and other popular contact-management software.
- Caller ID+Plus (DOS and Windows), Rochelle Communications (Austin, TX): a memory-resident contact manager and caller-ID system. It includes a call log and an import/export function.
- Call Link (Windows), DSG Communications (Saskatoon, Saskatchewan, Canada): offers an elegant way to relay caller ID to external applications using DDE.
- CentrexMax (Windows), Dees Communications (Vancouver, British Columbia, Canada): features fully integrated caller-identification software based on the popular Modatech Maximizer contact-management system.
- Intellect, Clearwave Communications (Fort Collins, CO): a hardware/software product that integrates phone, fax, modem, computer, voice mail, and answering machine.
- InterActive Communicator, InterActive (Humboldt, SD): a PC/phone combination that acts as a communications center.

A number of IC makers, including Exar, Mitel, Motorola, and Sierra, provide caller-ID receiver chips. In addition, modem chip makers AT&T, Rockwell, and Sierra provide caller-ID decoding in some of their products.

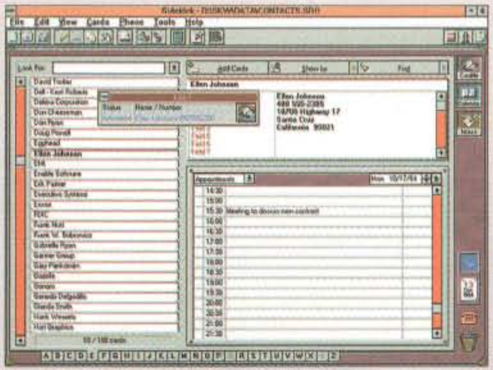
Residential Products

Caller-ID display units sell for $39 to $119; those with higher memory capacity and more features cost more. You can purchase

Sidekick for Windows Gets a Kick with Caller ID

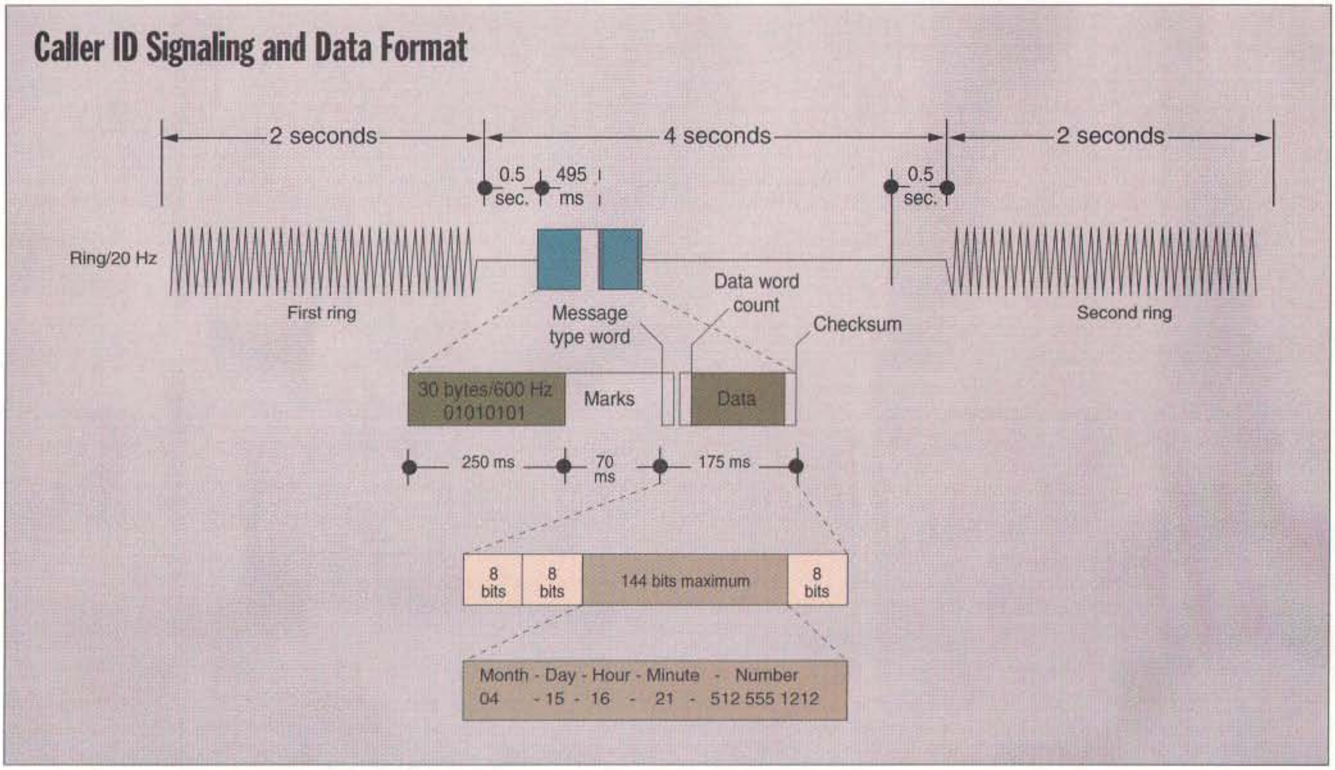
Software developer Borland International (Scotts Valley, CA) has incorporated caller-ID capability into Sidekick for Windows, Borland's personal organizer equipped with a flexible calendar and card-file and note-taking features. Caller ID automatically displays the Sidekick card-file information as the telephone rings, enabling users to prepare themselves for important calls and to better manage their telephone activity. Another benefit is a call-logging feature, which shows the date, time, duration, and origin of all incoming calls and makes Sidekick a virtual answering machine.

Sidekick's new capabilities are the result of a business and technology partnership between Austin-based Rochelle Communications and Borland. Rochelle produces and markets single-line and multiline caller-ID interface devices. Sidekick users can purchase Rochelle's single-line ANI-232 decoder unit for $80.



The pop-up window for Sidekick's caller-ID feature.

Caller ID Signaling and Data Format



In the U.S. and Canada, caller ID is transmitted as a Bell 202 modem signal between the first and second rings. The single-message format is the most commonly used and provides calling-number information, the date, and the time. By dialing *67, callers may block the transmission of their phone number, and a "P" (for private) appears in the number field. Calls from outside your area, on the other hand, are identified by an "O" in the phone field. If the subscriber picks up the receiver before the second ring, the caller ID is not transmitted. (Illustration courtesy of Motorola)

them from telephone company fulfillment agents, telephone and electronics specialty stores, and mail-order companies. A second generation of caller-ID display units provides additional features, such as the blocking of selected calls or speed dialing. At the high end of the market, integrated telephone sets that include caller-ID displays and cordless telephones sell for $99 to $299.

Many software products link caller ID to a PC and provide a pop-up screen containing information on the caller, if he or she is in the database. See "Caller ID Products" on page 150.

Caller ID Developer Tools

Many developer toolkits and application generators exist for VARs and programmers who want to integrate caller-ID information with other applications. Rochelle Communications (Austin, TX) sells developer toolkits for DOS, Windows, OS/2, Unix (Sun, SCO, AIX), and the Macintosh. Caller-ID voice application generators are also popular. Stylus Innovations (Cambridge, MA) provides caller-ID support in its Visual Voice application generator for Visual Basic.

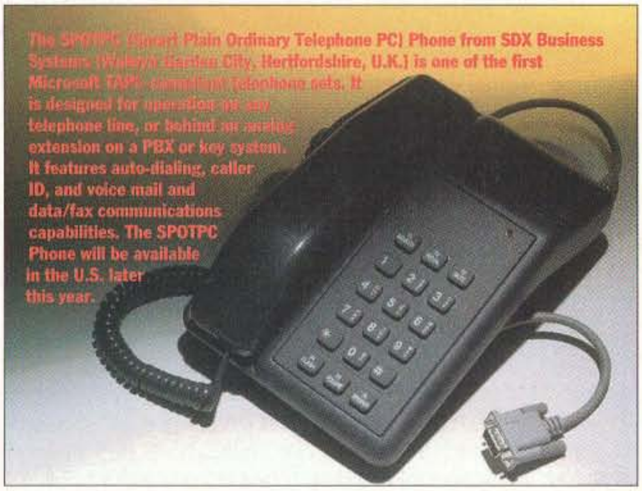
For developers interested in voice applications under OS/2, ComTel Telecommunications (Bethesda, MD) offers an application generator that is compatible with Dialogic and Natural Microsystems voice cards. Voice Power Technologies (Austin, TX) markets Voice Manager, a Unix-based voice application generator for service-bureau applications. Davis Associates (Belle Mead, NJ) sells a caller-ID application generator based on Paradox that lets you customize the database program for order entry, service management, and telemarketing.

Integration Options

To use the features of caller ID to full advantage, users must be able to take the data supplied by the telephone company, put it into applications, and link it to existing databases. Today, the path to integrating the various elements into a useful whole can be littered with pitfalls. To overcome potential problems, a number of vendors provide applications, code libraries, and development tools that can significantly cut development time and cost. Integration of existing applications to telephony services can be as simple as buying an off-the-shelf application that communicates with the target application. The primary integration options are listed below.

Memory-resident keyboard macros. These programmable macros store a sequence of commands and are inexpensive and simple to implement. But often they require redundant databases and can be clumsy.

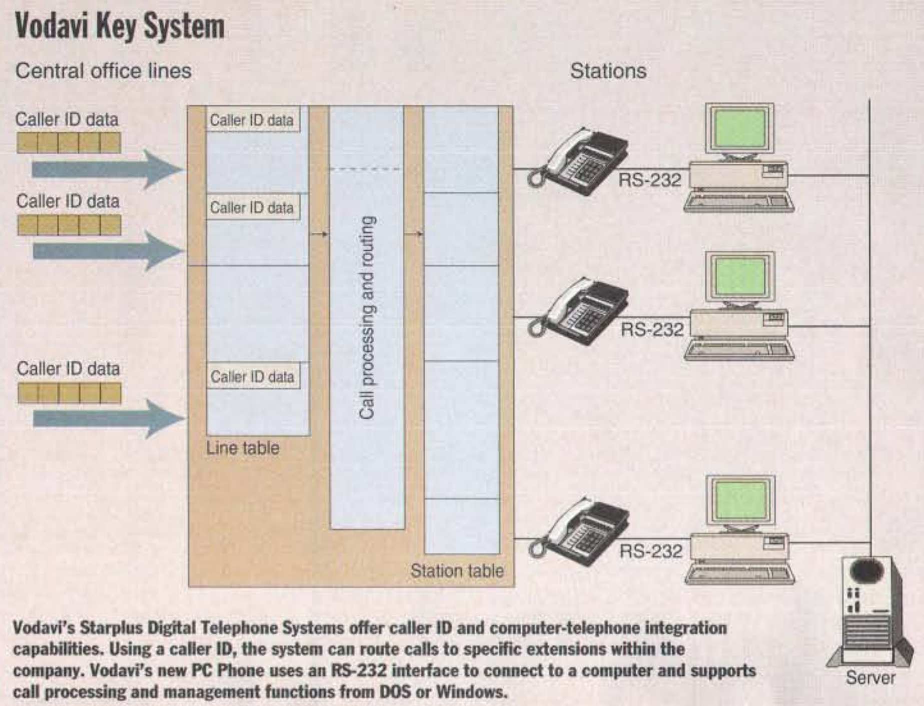
Custom development. You can



The SPOTPC (Smart Plain Ordinary Telephone PC) Phone from SDX Business Systems (Welwyn Garden City, Hertfordshire, U.K.) is one of the first Microsoft TAPI-compliant telephone sets. It is designed for operation on any telephone line, or behind an analog extension on a PBX or key system. It features auto-dialing, caller ID, and voice mail and data/fax communications capabilities. The SPOTPC Phone will be available in the U.S. later this year.

Vodavi Keys Into Caller ID Business Applications

While telephone companies were busy conceptualizing caller ID as a service for their residential customers, companies like Vodavi Communications Systems (Scottsdale, AZ) were concentrating on using its powers for the betterment of business. Identifying small- to medium-size businesses as its target market, Vodavi integrated computers and telephony, introducing the first ICLID (Incoming Caller ID) key telephone system in 1991 (see the figure).



Vodavi's Starplus Digital Telephone Systems offer caller ID and computer-telephone integration capabilities. Using a caller ID, the system can route calls to specific extensions within the company. Vodavi's new PC Phone uses an RS-232 interface to connect to a computer and supports call processing and management functions from DOS or Windows.

Its value to businesses with busy call centers seemed an obvious one to Ron Pavlak, manager of marketing and strategic planning for Vodavi. "Telephone companies have mismarketed caller ID from the beginning by directing it to residential customers," Pavlak says. "It is an ideal small-business management tool that enables [companies] to provide personalized customer service, screen calls, control interruptions, effectively manage volumes of calls, and reduce fraud."

By using ICLID information, key system users can save an average of 20 seconds per call, a significant accomplishment when you consider the irritation customers sometimes feel toward the business that has just kept them on hold for 30 seconds. A loss of patience often translates into a lost sale.

Vodavi's current DOS-based product, Call Tracker, links the incoming number to a pop-up file on a company's customer database. The firm expects to release a Windows-based PIM in 1995.

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tailor applications to the exact needs of the user, but development expense may be prohibitive.

DDE. Dynamic exchange of data is effective if done right, but it does not necessarily link all data sources. Also, DDE is not available on all operating systems.

ODBC (Open Database Connectivity). ODBC lets one application access multiple database sources. It can provide seamless integration with leading databases but is not yet available with most applications.

DLL. DLLs provide access to a wide variety of caller-ID functions. Caller-ID vendors provide DLLs that can be quickly linked to a user's application.

Telephony APIs. Sets of programming interfaces available from Microsoft (TAPI), Novell (TSAPI), and other vendors give programmers access to a standard set of telephony functions, including caller ID. Telephony APIs do not resolve database connectivity issues.

caller-ID-enabled applications. Many end-user applications support some form of caller-ID connectivity. Often, you can link these applications to other programs to provide caller lookup from a PIM (personal information manager) or an external database.

ESP—Exemplary Service Professionals

In today's competitive environment, the quality of customer service is fundamental. Knowing who is calling and having instant access to pertinent information translates into savings on the bottom line and increased revenues. For example, important or repeat customers can be tagged to receive special handling. But a word of caution is in order. Many customers are turned off by being greeted by name before they have had a chance to identify themselves. The key to taking advantage of caller ID is not to impress the caller with "psychic" powers but to quickly access relevant information so that you can personalize the quality of your service. ■

Gilbert Amine and Annette Riggio are vice president for business and product development and manager of marketing communications at Rochelle Communications, respectively. You can contact them via MCI Mail at 653-9166, via CompuServe at 74032,712, or on BIX c/o "editors." Ellis Hill is president of Research First Consulting in Birmingham, Alabama. You can contact him via CompuServe at 73243,2260 or on BIX c/o "editors."

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High-Tech Bookkeeping

New technology is changing the face of the small business's ledger

KENNETH M. SHELDON

Time is money. And the more time you spend maintaining your business's finances, the less time you have to actually *make* money. Fortunately, several new technologies could change the way businesses keep their books on computer and result in increased productivity for even small offices.

The typical finance or accounting program contains a great deal of information that would be valuable to share with other applications. Most of the accounting and personal-finance programs let you export a file that a spreadsheet or word processing program can use. A few programs, however, also support Windows' DDE technology, which would let you, for example, automatically export sales figures into an Excel spreadsheet that compared sales over the course of several months or years.

One such package is Peachtree Accounting for Windows. Circuits & Systems Inc. (East Rockaway, NY) developed Chaver-ware, a membership-management program for synagogues. It uses Peachtree's package for its accounting module. According to Rob Hirsch, senior vice president for Circuits & Systems, DDE links make it easy to send invoices to synagogue members for things like dues and religious school tuition. The user clicks on a button, and Chaver-ware sends that information by DDE link to Peachtree, which then creates an invoice.

Going a step beyond DDE, Microsoft's OLE technology allows users to create links to other applications and to automatically open those applications and edit objects without leaving the original application. Peachtree uses OLE in its forms designer. Clicking on a clip-art object in the forms designer opens a window to the associated application (such as Windows Paintbrush), with access to a full set of editing tools.

Another product that makes use of OLE is MTX Accounting from MTX International (Englewood, CO) for Microsoft Office. Built around Microsoft Access, MTX Accounting provides tools that let users track and analyze their accounting information. Bill Glasier, president of Sentry Medical Products of Englewood, Colorado, uses MTX Accounting to search his accounting database for customers who have not made purchases within a specified time. When he selects the option, MTX automatically launches Microsoft Word and merges those customers' names and addresses with a document that thanks them for their business and offers them a discount on their next purchase.

From Checkbook to Balance Sheet

Whether you choose a personal-finance package or a true accounting program to maintain your company's finances depends on your business. When making your decision, consider the following questions:

Do you operate on a cash basis? While a personal-finance program can easily track cash income and expenses, dealing with payables, receivables, or aging generally requires a more full-fledged bookkeeping or accounting program.

How many employees do you have? Tracking the government's requirements for payroll deductions calls for a system that will support separate "accounts" for withholding or unemployment insurance. While some personal-finance packages can be adapted to perform these functions, a program specifically designed for the task will generally be more flexible and easier to use.

Do you have a large, changing inventory? If you need to track a large number of items, stock on hand, quantities ordered, and so on, you'll need a package that provides flexible inventory management. Accounting packages will be stronger in this area.

Do you deal with multiple customers or vendors? A true accounting package will provide more flexibility than a personal-finance package when it comes to dealing with a large number of customers and vendors.

Do you have an accounting background? Some packages require you to be familiar with standard accounting terminology like credits, debits, and posting. Others substitute plain-English phrases for accounting jargon, making it easier for non-accountants to set up and maintain the system.

Do you require a GAAP-compliant system? Generally Accepted Accounting Principles require such features as the inability to delete transactions (to maintain a complete audit trail). For a small business, that may be an unnecessary and even bothersome feature.

Small Business on Small Disks

Peachtree Accounting for Windows is now available in a CD-ROM edition that includes, along with basic program files, a large selection of clip art, label-creation software, and a CompuServe link. The disk also provides on-line documentation for the program, as well as Allegro's Multimedia Business Library of 12 financial books.

Another company that now provides its software on CD-ROM is Intuit (Menlo Park, CA), whose Deluxe edition of Quicken 4 for Windows includes on-line documentation, multimedia tutorials, and interactive advice from financial experts. As this story was being written, Microsoft announced that it was in the process of buying Intuit and selling its Quicken competitor, Money, to Novell.

Taking Businesses On-Line

Another technology that may affect the way small companies do business is the advent of on-line electronic services such as banking, bill payment, and credit-card reconciliation. Many personal-finance programs already let users pay bills and update stock prices electronically, using commercial services available through on-line systems such as CompuServe or Prodigy. These are straightforward, one-way transactions that take place through the ACH (Automated Clearing House) network maintained by the Federal Reserve.

Bringing complete electronic banking to PC users has taken longer, because setting it up is more complicated, due to the restrictions on access to an individual's banking data. Providing electronic access to the data requires a cooperative relationship between the service provider and the bank.

Individual banks can sell on-line services to their customers, but most don't have the expertise or software to do so. And any service provider or software company wanting to provide electronic banking services to users has to strike a separate deal with each individual bank.

Nevertheless, a few software companies have made forays into the field. Microsoft Money has a Bank On-Line option that lets you bank electronically, but you must have an account with one of the four banking institutions connected with the service: U.S. Bank, First National Bank of Chicago, Michigan National Bank, or Chase Manhattan Bank. Microsoft is negotiating to include other major banking institutions, which, it says, will significantly enhance your ability to link to banks.

Microsoft's electronic banking services are delivered by National Payment Clearinghouse Inc. (Downer's Grove, IL), which provides services in cooperation with local banks. Interestingly, NPCI is owned by Intuit, which incorporated NPCI's services into its own financial services hub for Quicken users. If the above-mentioned services are integrated into Windows 95, and if the purchase of Intuit goes through, Microsoft will be in a position to provide a tremendous range of on-line services for both individuals and companies.

Peachtree Accounting for Windows is also poised to leap into the arena of online services. Last year, Peachtree was acquired by Automatic Data Processing (Roseland, NJ), a major provider of computerized services (e.g., automated payroll) to businesses. ADP markets a service to banks called Business Express/PC, which lets business users check their account's status whenever they want, view transaction history, transfer funds, and perform other banking functions.

Taking Down the Barriers

For individual users, one barrier to on-line banking and bill payment services has been cost. At $10 to $15 per month, many people don't pay enough bills or do enough banking to make the services worthwhile. However, for businesses, which may conduct hundreds of such transactions a month, the cost isn't a barrier.

So why aren't businesses clamoring for on-line services? And why aren't vendors of accounting programs providing them?

To begin with, setting up electronic banking for businesses is even more complicated than doing it for individuals. Because businesses generally handle more money than individuals, there's more risk involved in making accounts accessible via telecommunications, not to mention special regulatory issues. Also, banks maintain business accounts separately from personal (or "consumer") accounts. On top of that, many business users are afraid of online services. A primary concern is usually the lack of a paper trail.

On-line banking also presents security issues for businesses. In an office where more than one person has access to the accounts, security measures such as password protection are a necessity. Without them, an employee could easily transfer money to a private account. Most on-line services use a PIN (personal identification number), like those used to access accounts via a bank's ATM machine. For security purposes, larger businesses will require multilevel passwords that limit access to sensitive areas.

Businesspeople in general and accountants in particular tend to be a technologically conservative lot. There's too much at stake to invest in technologies that aren't tested and true. Nevertheless, a booming market indicates that small businesses want to computerize their books and may be more willing to try new technologies like CD-ROM delivery and on-line services that could make their lives easier. ■

Kenneth M. Sheldon is a freelance author who has written extensively for BYTE and other computer publications. You can contact him on the Internet or BIX at ksheldon@bix.com.

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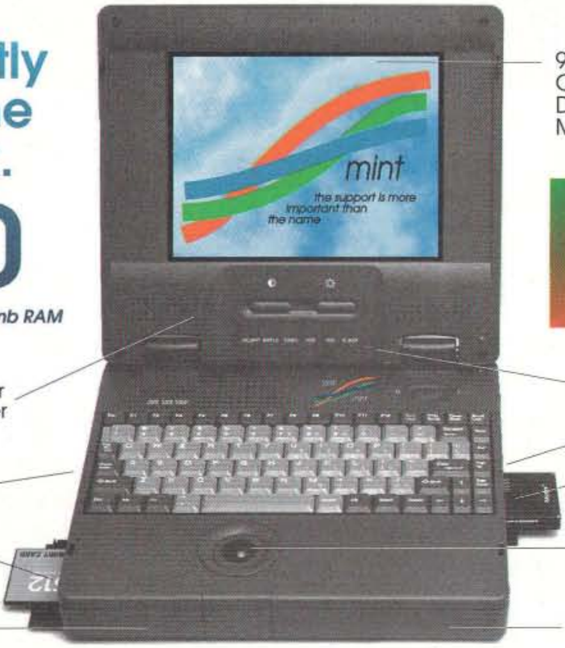

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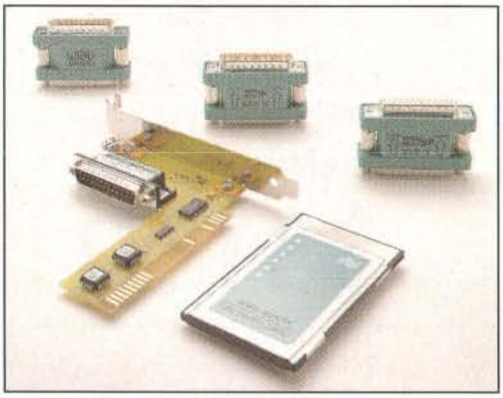

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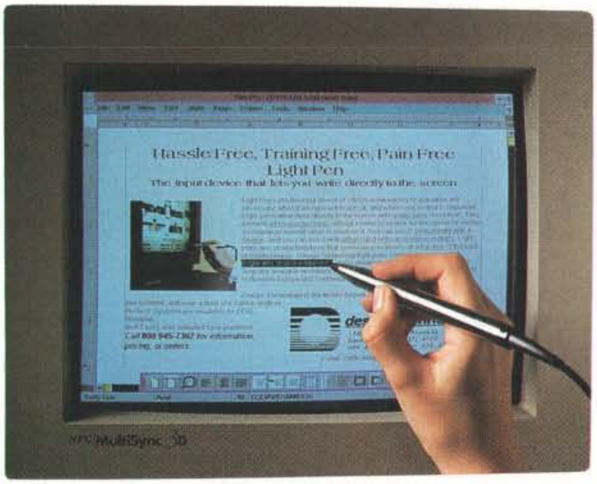

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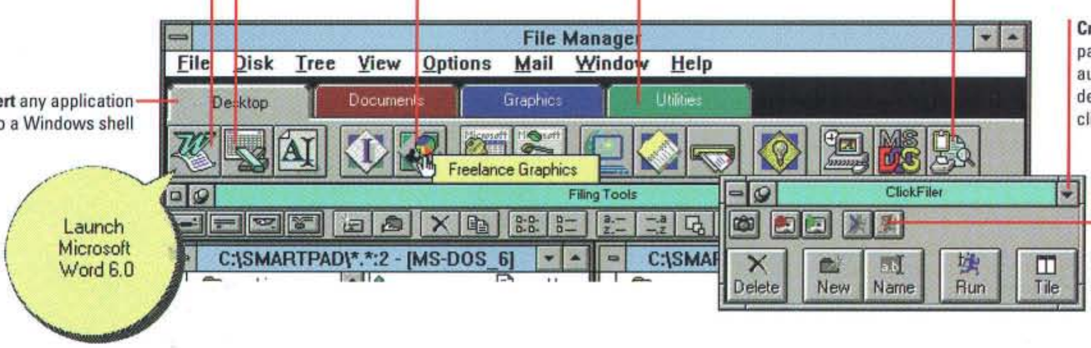

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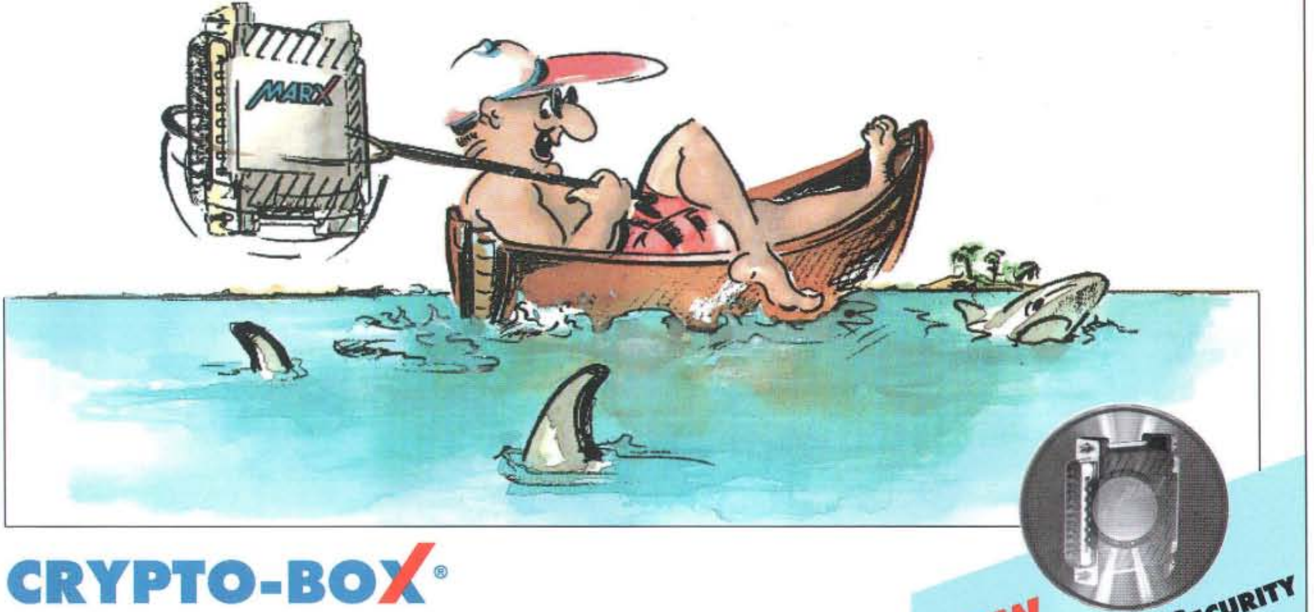

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Quad-Speed CD-ROM Delivers

But you need a fast PC for best results with these four new units

MICHAEL NADEAU

The standard-issue double-speed CD-ROM drives found on most PCs today are no longer good enough to play back multimedia software. They simply can't read and send the data fast enough to the computer's processor, graphics accelerator, and sound card to maintain smooth, uninterrupted operation. In business, this is a serious issue. Jerky video and choppy audio can destroy an otherwise strong presentation or diminish the effectiveness of a training film.

Quad-speed drives, which spin at twice the rate of double-speed CD-ROM drives, have been available for several years, but only as bulky external units and at high prices. Four companies—TEAC, Plextor, NEC Technologies, and Toshiba—recently introduced quad-speed drives priced from around $475 for some internal models to as high as $775 for external drives. Although you still pay significantly more than you would for most double-speed models, these drives are well worth the price—as long as you install them in a PC that is properly equipped to handle them.

Just because the data access rate of a quad-speed drive is twice that of a double-speed unit (600 KBps vs. 300 KBps) doesn't mean that you will see a doubling in performance. The truest measure of multimedia playback performance is the throughput to the video display or other output device, and that depends a great deal on the computer's processor and graphics accelerator. If one or both are too slow, the quad-speed drive will be in a hurry-up-and-wait mode much of the time. This is especially true for CD-ROM drives with large, intelligent caches. A quad-speed drive will provide better throughput on nearly any PC, but to get your money's worth, you need to install it in at least a 50-MHz 486DX2 system with a 64-bit local-bus graphics accelerator card.

Another consideration: Your system can play back video no faster than the data rate at which it was recorded. To accommodate single-speed models, the lowest common denominator among CD-ROM drives, the video for most commercial titles is recorded at a rate of about 150 KBps. A higher data rate will improve the video quality, but if you play back that video on a drive that's slower than the rate at which the video was recorded, you will get a slow, jerky mess. By the end of this year, quad-speed drives are expected to become the unit of choice, and software developers are just now beginning to optimize video for quad-speed drives.

A stack of four quad-speed CD-ROM drives (from top to bottom): TEAC America's SuperQuad, Toshiba's XM-3501B, Plextor's 4Plex, and NEC Technologies' MultiSpin 4Xe. List prices with host adapter range between $549 and $645. The TEAC drive uses a proprietary AT interface compatible with some Sound Blaster cards; the other three are SCSI drives. The NEC is an external unit (internal also available); the others are internal. The Plextor and Toshiba drives provided the best performance.

Four Quads

The four drives I tested were the NEC MultiSpin 4Xe Model CDR-601K, Plextor 4Plex PX-43CH, TEAC SuperQuad Model CD-55A, and Toshiba XM-3501B. All the drives are half-height or smaller and come with a suite of software that includes drivers for DOS and Windows, a utility for playing audio CDs, and installation software. You can also buy external Mac versions of all but the TEAC drive. Each of the drives has a headphone jack and an audio-line-out connector for use with sound boards. All review units except for the NEC were internal drives.

Compared to NEC's MultiSpin 4X Pro, introduced in 1994, the new 4Xi and 4Xe drives offer less in the way of performance and features but cost almost $200 less. However, the external NEC MultiSpin 4Xe ($515 without adapter) is still feature-rich. It automatically senses audio CDs and plays them as such when you insert them. Standard audio CD controls are on the front panel. Audio capability is built into the drive unit, so you don't need to have a sound board in your PC. You will need speakers, however. An EPP (enhanced parallel-port) connector on the back of the unit lets you use the unit with EPP-equipped portables, providing a theoretical 1-MB-per-second transfer rate. A lens-cleaning system inside the unit keeps the dust that gets by the 4Xe's double dust door from interfering with disc reads. NEC supplied a 16-bit Trantor ISA SCSI-2 adapter and its own drivers. The 4Xe was the only unit to come bundled with CD-ROM titles: Microsoft Encarta and NEC's CD Tutorial. An internal unit, the 4Xi, is also available ($415 without adapter).

The Plextor 4Plex PX-43CH ($489 without adapter) came with a Future Domain TMC 1610 16-bit SCSI-2 ISA adapter. It differs from the Future Domain adapter used by Toshiba only in that it has its own ROM BIOS. Plextor, like the vendors of other drives reviewed, offers several adapter options, or it will sell the unit without one. The drivers supplied were based on Corel's PowerSCSI product. At 1 MB, the Plextor drive has the largest built-in cache. The external 4Plex PX-43CH goes for $599 without an adapter.

TEAC's SuperQuad is unique among the group not only because of its slim 1-inch-high profile, but also because it uses a motorized tray rather than a separate disc caddy. It is also the only drive that isn't a SCSI device. TEAC uses Creative Lab's proprietary version of the AT interface (aka IDE), which works with Sound Blaster cards. The others use SCSI adapters. In spite of the AT interface, the TEAC drive doesn't have a price advantage ($599 with interface card). Because of its AT interface, the TEAC is the only drive that doesn't come in a external model, but it was the simplest internal unit to get up and running. The adapter has no jumpers or DIP switches to set, and if you wish, you can run the drive off a sound card. I tested the TEAC unit running from the included AT adapter and from a Sound Blaster 16 sound card and found only minimal performance differences.

Toshiba offers three models of the XM-3501. I tested the internal XM-3501B ($470 without adapter). The TXM-3501E ($600 without adapter) is the external version, and the TXM-3501A4 ($2470) is a four-drive unit. All can be mounted horizontally, vertically, or even diagonally. Toshiba supplied a Future Domain TMC1610-MEX, 16-bit SCSI-2 ISA adapter that uses Toshiba's own drivers.

How I Tested

I ran three sets of benchmark tests on the four drives on a Dell Dimension 466V with a 66-MHz 486DX2 CPU, a 64-bit Number Nine #9GXE64 VL-Bus graphics accelerator, and a Creative Labs Sound Blaster 16 audio card. For comparison, I also ran all tests on the CD-ROM drive that came with the Dell, a double-speed Matsushita Model CR-563-B (see the benchmark table, "Quad-Speed Performance").

The first set was a suite of low-level tests called CDStone (version 1.1), which was developed by The Profit Group (Tucson, AZ). It measures seek time across the entire width of the disc (full stroke), across one-third of the disc (one-third stroke), and across random distances. A good full-stroke score indicates that the drive can locate a specific track more quickly. The one-third stroke test is most commonly used as a standard means of rating the seek times of CD-ROM drives. The random-distance test more closely represents real-world circumstances.

CDStone also measures the read rate for both large and small blocks of data. A good score on the large-block read test is an indicator that the drive can handle video and audio files well, and the small-block test reflects a drive's likely performance with database or other text files. Finally, CDStone measures CPU use during data access at 150 KBps and 300 KBps. CDStone then provides an overall index of performance, using a typical single-speed drive as the baseline.

The second test suite consists of three well-known animation files—Robo Truck, Roller Coaster/Mount St. Helens, and AutoDesk Building—that were created using AutoCAD. The scores are simply the number of seconds each required to complete each animation.

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The last suite was meant to separate the wheat from the chaff. It consisted of four versions of the same video file: an Intel TV ad. All four ran using Video for Windows. Three used Cinepak video compression but were recorded at different data rates: 150 KBps, 300 KBps, and 600 KBps. The last version was recorded at 475 KBps, using Indeo compression, which is much more CPU-intensive. I used the Intel ad because it was available at the higher data rates.

Remember, most commercial CD-ROM video is recorded at lower rates. While a good double-speed drive should be able to play back a clip recorded at 300 KBps, it will choke on anything recorded at a higher rate. On the other hand, video recorded at 300 KBps or lower presents no challenge at all to a quad-speed drive.

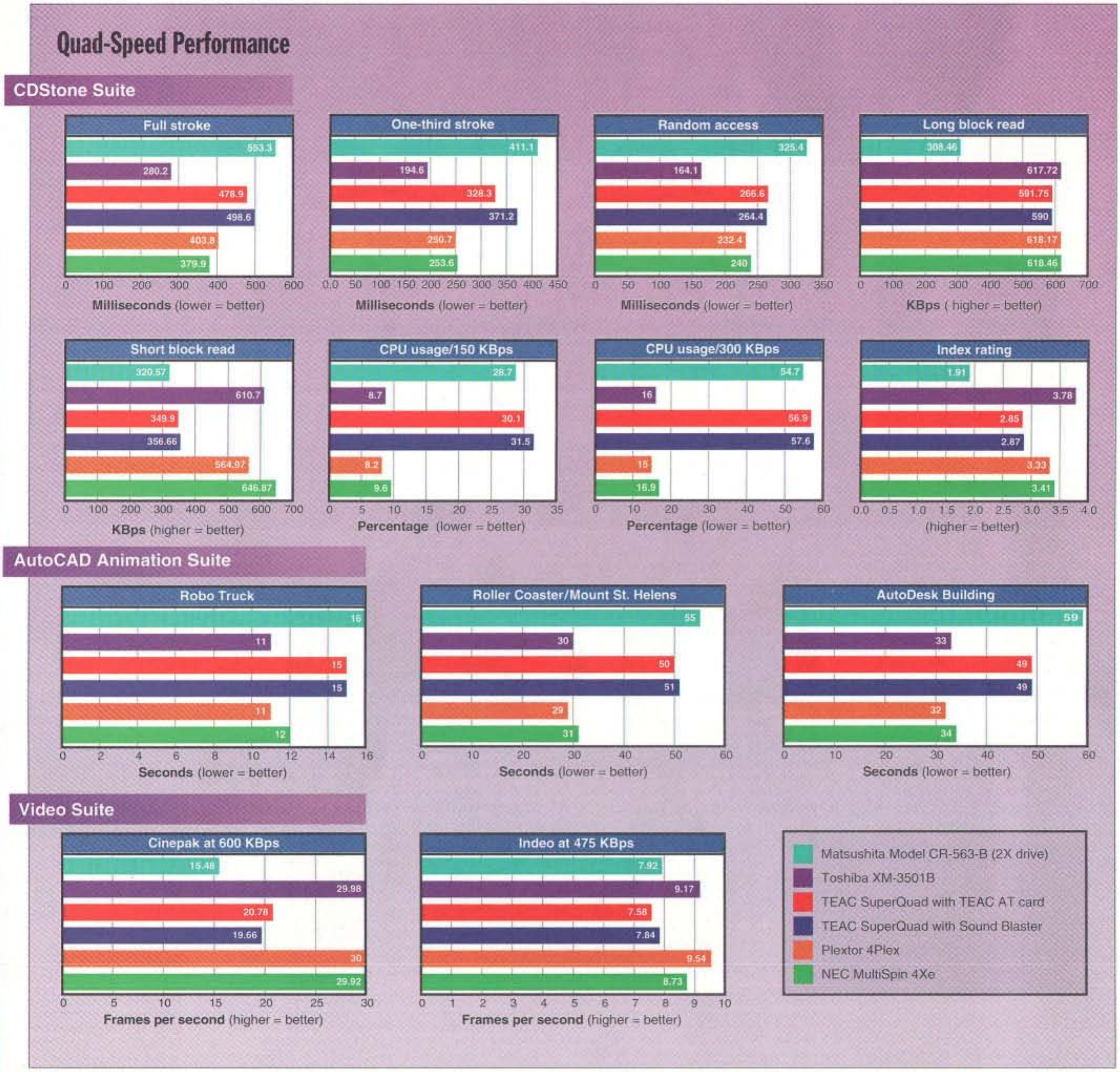
Head-to-Head

I evaluated each unit for ease of installation, performance, and value. Installing each drive was a snap. The external NEC unit was, of course, the easiest to install: I simply inserted the adapter and plugged in the power and SCSI cables. After mounting the internal units, I plugged in the power, SCSI or AT, and sound cables. Only one snag arose: The Plextor drive had a different sound cable connector from the one that came with the Sound Blaster board.

Loading the drivers had greater potential for presenting problems, but surprisingly, driver installation was successful on the first try on three of the four units. The PowerSCSI drivers that came with the Plextor's Future Domain adapter didn't get along with the driver for the Number Nine graphics accelerator. After trying various settings, I got the two working together, but only by disabling Microsoft's EMM386 memory manager as well. If you want to use the Plextor drive with the #9GXE64, check with Future Domain and Number Nine first to see if they have updated their drivers, or use a different SCSI adapter.

All the vendors hype their drives' 600-KBps transfer rates and low average seek times, but I found seek time ratings a poor indicator of overall CD-ROM drive performance. The tests placed the Toshiba and Plextor drives almost even at the top, with a slight edge to Plextor. On the low-level CDStone and 600-KBps video tests, both drives were almost twice as fast as the double-speed Matsushita drive. The Toshiba and Plextor were about 45 percent faster than the double-speed drive on the animation tests, and about 14 percent faster on the Indeo video test. Every drive tested ran the 150-KBps and 300-KBps video tests at the full 30 frame-per-second rate, and every quad-speed drive except the TEAC also ran the 600-KBps video test at the full frame rate.

In the CDStone and AutoCAD animation tests, the NEC unit ran 3 percent to 9 percent behind the leaders; it was about 9 percent slower than the Plextor on the Indeo video test, for example. The TEAC drive brought up the rear. To keep things in



Quad-Speed Performance

All tests were run on a Dell Dimension 66V (66-MHz 486DX2) with a 64-bit Number Nine VL-Bus graphics accelerator. The Dell's double-speed Matsushita CD-ROM drive served as a basis for comparison. The CDStone tests measure access times (full stroke, one-third stroke, and random access) and data read rates (long block and short block), as well as CPU use. The CDStone index uses a typical single-speed drive as its baseline. The AutoCAD animation tests simply measure the time it takes each of three AutoCAD animations to complete. The video tests shown here measure the frame rate playback and completion time of two versions of the same Video for Windows file. One uses Cinepak compression and is recorded at a data rate of 600 KBps. The second uses Indeo compression and is recorded at 475 KBps. Note that all the drives, even the Dell's original double-speed Matsushita, ran 150-KBps and 300-KBps files at their full rate.

perspective, however, keep in mind that all the quad-speed drives blow the doors off even the best double-speed units available. The TEAC, slowest of the bunch, was still 50 percent faster than the double-speed Matsushita on the CDStone tests and up to 20 percent faster on the animation tests.

So here's the bottom line: All the quad-speed drives I tested will play most commercially available multimedia equally well on a fast PC. That leaves you to consider price, features, and the future. If performance with future applications is your overwhelming concern, or if you're developing those applications, then either the Toshiba or Plextor units will serve you well. The NEC provides lots of extras for a moderate price, and isn't that far behind the two performance leaders. The AT interface gives TEAC an edge when it comes to simplicity, but when more demanding video hits store shelves, TEAC's slow performance could be a liability. ■

Michael Nadeau is a BYTE contributing editor and author of The BYTE Guide to CD-ROM *(Osborne/McGraw-Hill, 1994). You can reach him on the Internet or BIX as miken@bix.com.*

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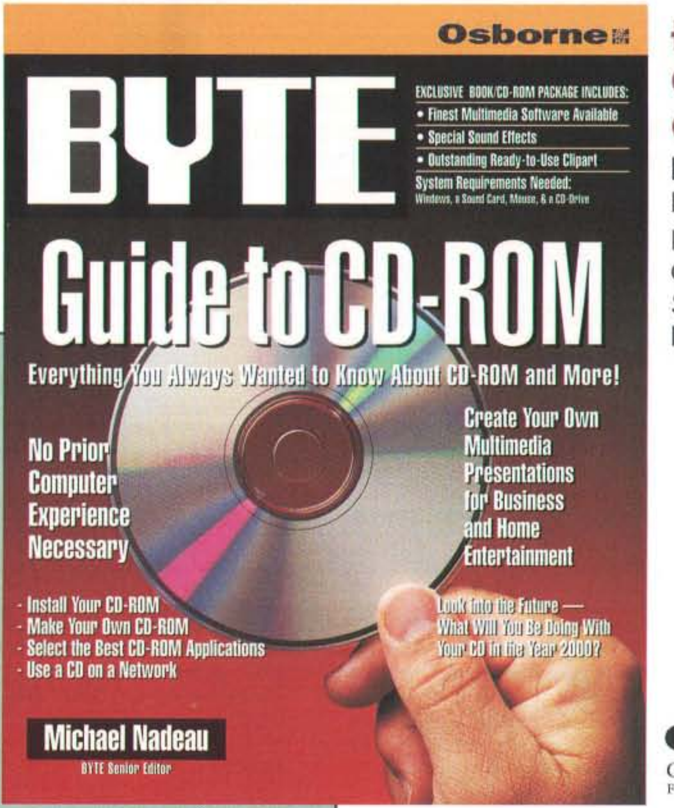
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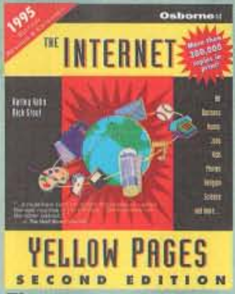

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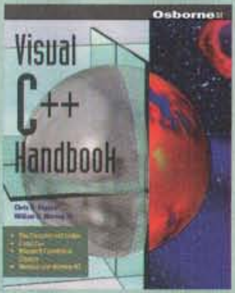

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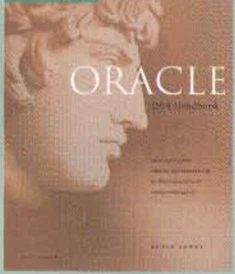

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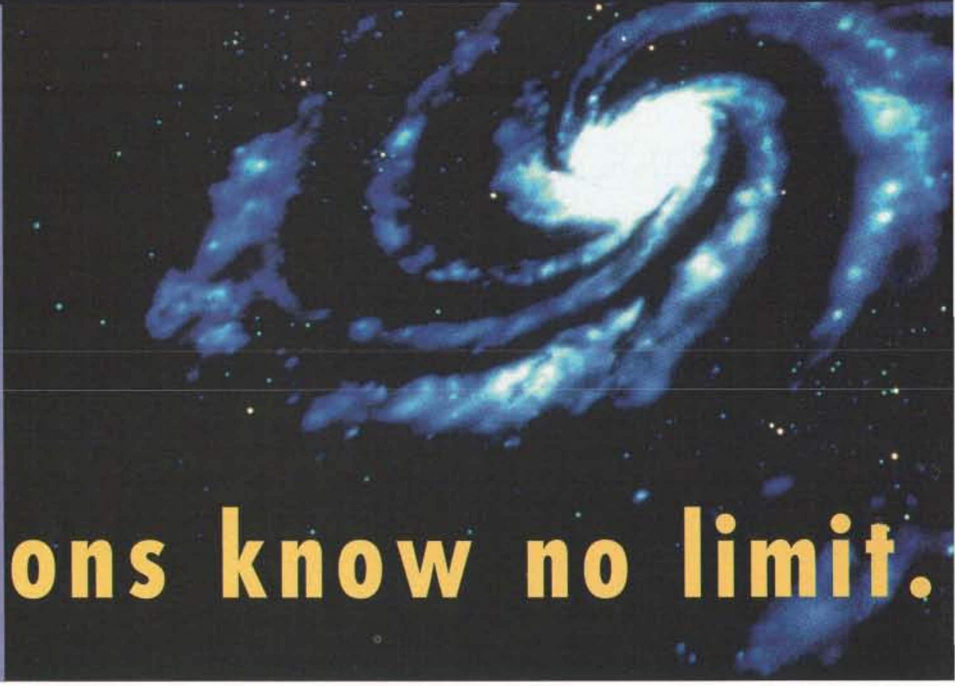

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Lively Pictures

HSC's Live Picture features state-of-the-art technologies for enabling high-end image editing on the Power Mac

TREVOR MARSHALL

My first contact with Live Picture was in June 1993 during the Digital World trade show. A rumor was circulating that Kai Krause (author of Kai's Power Tools, and HSC Software's chief technical visionary) was secretly showing a radically different image-editing program. Jerry Pournelle and I found Kai in a darkened suite that was packed with people and equipment, waxing long and hard about an early version of a new package from France called Live Picture. Using acronyms such as FITS (Functional Interpolating Transform System) and IVUE (for Image VUE, a French-language acronym), Kai tried to convince us that conventional pixel editors like Adobe Photoshop and Corel Paint would soon be relegated to the technological scrap heap.

Well, it has taken some time, but Live Picture is now shipping, and the current version is radically different from the one Jerry and I saw in 1993. No longer does HSC Software intend it to replace Photoshop, which you will need for some tasks.

However, Live Picture makes fast image editing more affordable than it has ever been before. At $3995, Live Picture is only a fraction of the cost of high-end workstation products from Quantel and Scitex.

Live Picture has already received wide acclaim, so I'll focus on just what you can expect from the newer, native Power Macintosh version. My test setup consisted of a Power Mac 8100/80 CD equipped with 40 MB of RAM (8 MB more than required), an NEC MultiSync 5FG monitor, and a FARGO Primera PRO Dye Sublimation color printer. The Power Mac's internal video was set to 832- by 624-pixel resolution.

IVUE and FITS

Live Picture's key features have as much to do with the user interface as with imaging technology, but because it is not possible to understand how the program works without first taking a look at the IVUE image format, we shall, in fact, do just that.

Computerized images are typically scanned, transported, and stored in a pixel-mapped format (most commonly TIFF). And, while the images on a high-resolution video monitor can become quite large (e.g., my 832- by 624- by 24-bit monitor displays 2 MB of uncompressed data), an image that is being prepared for printing can be many times larger. An 8.5- by 11-inch page printed at 300 dots per inch would end up as a 25-MB image file. Normal image editors (Photoshop and Corel Paint) scan files of this size every time they refresh the screen display.

In practice, however, most of the pixels that are read from the file are discarded, and only a few are painted through to the screen. This technique is called *subsampling*. But when you apply an effect, such as the unsharp mask, every pixel in the main image file must be updated. Thus, much of an electronic artist's time is spent waiting for files to be processed.

Contrast the Collage software from Specular International (Amherst, MA), which lets the artist manipulate a proxy of the original image to speed up the operation of many page-composition (or compositing) functions. You form the proxy by sub-sampling the main image before

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Live Picture's IVUE technology uses mathematical abstraction to maintain high resolutions at widely varying zoom levels. Here, the zoomed-in view of the model's eye reveals a clear subimage that does not maintain its sharpness when printed out.

you begin the Collage session. Then you perform all the compositing on the proxy image, which contains only a fraction of the number of pixels in the original. At the end of the editing session, Collage carries out the same functions, at full resolution, on the original. Due to the smaller number of pixels being manipulated, it is much faster to compose a page with Collage than with a pixel-based editor. On the other hand, it is useless to use high levels of zoom on a Collage proxy, which is inherently low resolution.

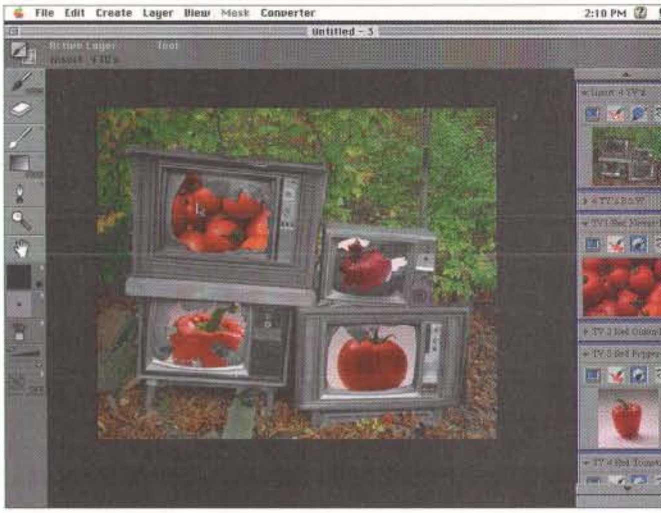
Live Picture uses two new technologies that effectively speed up the editing session without requiring any significant compromise in the ability to zoom in to fine image detail. The first is FITS. As does Collage, Live Picture stores any changes to the image as mathematical equations. But FITS uses new ways of representing these image changes. You are not constrained merely to making compositing functions but have available many operations that are new to personal computers.

Although the changes you make affect the image on your screen, nothing happens to the main database until you finish the session and activate the FITS RIP, the raster-image processing program that converts the file for output on a raster-based device. This shifts the waiting to the RIP post-processor, which can work as a background task that you activate at the end of the day or during a coffee break. Unlike the old methods, RIP postprocessing should not affect your creativity or your productivity.

Zooming In

The other new technology behind Live Picture is called IVUE, an image-storage format designed by FITS Imaging (Paris, France) to provide editing software with fast access to any portion of the main image at any zoom level. The IVUE file format contains the original high-resolution image and a series of reduced resolution subimages (thumbnails). The number of subimages depends on the size of the main image; the larger the image, the more subimages are produced during the conversion process. The smallest subimage is usually around 256 by 256 pixels. When an application requests pixel data, Live Picture determines which portion of each subimage to access.

Obviously, an IVUE file will be larger than the uncompressed TIFF version of the same image—around 33 percent larger, according to FITS Imaging. On the other hand, the TIFF format supports lossless compression, and the average TIFF file takes up much less disk space when stored in the compressed form. FITS Imaging offers a JPEG compression mode, but you can expect an IVUE database to eat up more of your disk than the TIFF database of the same images. This is a small price to pay for the increase in speed obtained using IVUE-aware applications, such as Live Picture.



Like Adobe Photoshop 3.0, Live Picture lets you assemble images from multiple layers. Thumbnails of three layers appear at the right, with the base layer at the top.

An IVUE file is larger than the corresponding TIFF file because it contains several sets of images. But, because an IVUE file is structured like an indexed database, the program can display any part of any image onto the screen, at any zoom level, very quickly. Live Picture generates the screen display by interpolating between the appropriate IVUE thumbnails. At some levels of zoom, you can see the monitor first display a coarse version of the image, with the fine details painted later. But you have to be observant; on my Power Macintosh's internal video, both the coarse and detailed images were finished in just 1 or 2 seconds.

The two screens on page 171 show a concept that Kai Krause used at the 1993 meeting to demonstrate IVUE's high resolution. They show the technology's potential and its shortcomings. The screen on the right was created by zooming in on the glint in the model's right eye, showing that the glint is in fact a complete high-resolution "reflection" of the model's head. You can also see that this zoom level is too high. The interpolation artifacts in the original scanned image are clearly visible even though the edited subimage is perfectly clear on the screen. An HSC spokesperson says that Live Picture could not introduce such interpolation effects, however.

Because high resolution is maintained at different sublevels of the main image, there is no inherent pixellation in a Live Picture image. Although I can imagine that some high-tech spy might get a kick from hiding a highly detailed secret document inside portions of an otherwise innocuous image, it is hard to imagine any practical use for Live Picture's ability to handle such a wide range of resolutions. In fact, what you see on the screen is not what you will see on the printed page (a limitation, to be sure, of other image editors as well). When printed, this reflection will again become a pixellated glint. Artists don't have to worry about pixellation at the screen level, but they'll need to pay attention to the resolution in the final printing process.

Layers in Live Picture

Images are created in Live Picture by adding layers. When an image is imported, it becomes a layer. Or, you can create a layer of a particular background color. You can also make a layer transparent, opaque, or translucent.

The screen above illustrates the layering concept. On the right edge of the screen is a list of layers. Starting at the top is the base image: four scrap television sets with fractured screens. Next is a layer called "4 TVs B&W"–then "TV 1 Red Maters," "TV 2 Red Onion," and "TV 3 Red Pepper." The final layer, "TV 4 Red Tomato," is partly scrolled off the bottom of the display. Some of these layers have their corresponding thumbnail images opened and some do not, but each layer has a unique place in the composition on the screen.

Starting with the four TVs, I selected the outlines of the broken screens as masks and applied transparency to the "4 TVs B&W" layer in these specific areas. Masking is a task presumably all Photoshop users have done at one time or another, but performing it on a unique layer has one big advantage: The masking can be turned on or off at will. The original image remained unchanged. I then created new layers for the images of the vegetables, resized them, and placed them behind the appropriate TV screens.

What you see on the screen is really an

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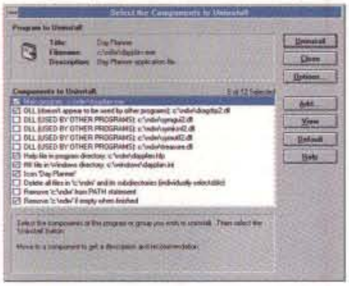

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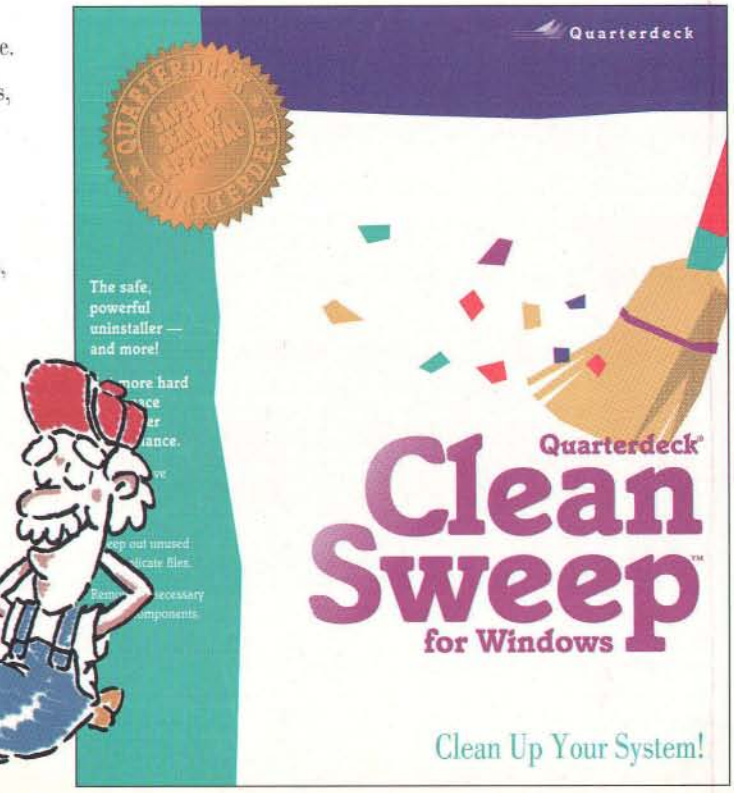

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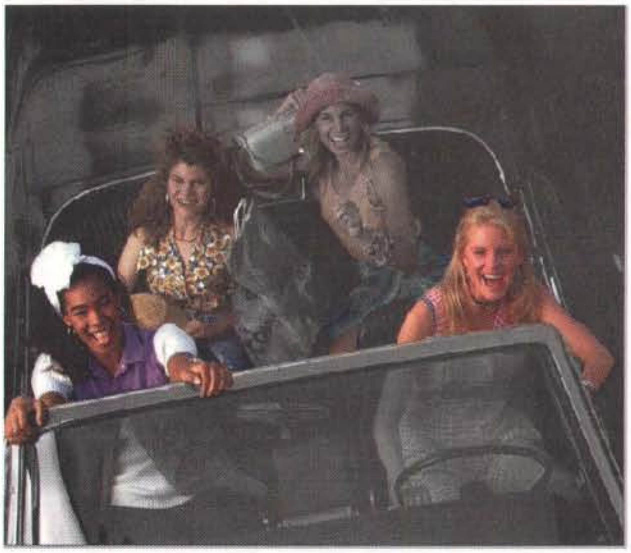
"object oriented" composition. To interchange, for example, the pepper and the tomato, you merely have to select those layers and drag the images into their new positions. With Live Picture, you can continue to work on any section of the image until you are satisfied.

Only after you've made all your design decisions do you activate the FITS RIP and create the output file for the new composition. Even then, the original image remains unchanged. The output file is created mathematically, according to the instructions programmed into the FITS file by your actions during the editing session. Such creative flexibility is absent in a conventional pixel-mapped editor, where once you have merged a new object, it is fixed into the image, and you are stuck with it. Some desktop products, including Fractal Design Painter on the Macintosh and Picture Publisher on the PC, support floating objects, but you must merge them before you save the final image.

The Fine Art of Transparency

For some time, Altamira's Composer has had a layered structure similar to Live Picture's. I have used this feature a lot, but it has a serious shortcoming: After you've applied transparency to a layer or an object, you can't easily remove or alter the transparency. But since Live Picture does not compute the pixel changes until your composition is complete, you can change transparency or any other attribute at any time.

The screen below consists of four layers: the original color image imported from the CD, and layers called "Blur the Car," "Girls Blk & Wht," and "Background." I added the "Blur the Car" layer to try to define the outline of the subjects more vividly by reducing the clarity of the other objects, namely the car. The "Girls Blk & Wht" layer started out as a monochrome version of the original image. After I added transparency in the regions around the subjects' bodies, the original color image started to peek through. Changing the transparency on the foreground subjects to 100 percent and on the background subjects to 40 percent and 60 percent, respectively, rounded out the composition. The process from start to finish took 10 minutes, most of which was spent thinking.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Varying the transparency of layers can produce interesting artistic effects. This image was created by overlaying the black-and-white photo over the otherwise identical color version, using an air brush feature to blur the car, and then increasing the transparency in front of the subjects to 100 percent.

A Unique Air Brush

I applied transparency with the air brush, which is the most useful tool introduced by Live Picture. The air brush generates a concentrated central stream and an area of "spray" that has a reduced effect as the distance from the center increases. I was not too careful brushing around the edges of the subjects—you can find defects if you look closely.

You can use the air brush to spray every effect in a Live Picture composition. You can air-brush paint, of course, but you can also "brush" unsharp mask, radial blur, transparency, or colorization. Every image editor needs a feature like this. It is such an obvious concept, and it makes an artist's job so much easier.

Take, for example, the unsharp mask. Artists most frequently use the unsharp mask to more clearly define the edge of an object. So why not just spray the mask around the outline, as Live Picture lets you do? It makes you wonder why computer artists have continued to put up with defining rectangular areas.

To test this feature, I imported a sports car image into Live Picture. After just three brush strokes and 30 seconds of work, I was able to distort the car's shape significantly. I applied two vertical brush strokes of the distort mask to the front bumper and to the middle of the rear wheel. The speed of application, or brush pressure, determined the effect's radius of action.

I could also unbrush this effect. By lightly brushing over the distorted area (with the erase function), I made the vehicle's original shape gradually reappear. Brushing reduced the distortion's intensity, eventually returning the car to its original outline. I tried the Gaussian blur effect , which also could be removed, incrementally, by brushing with the eraser. By allowing you to spray an effect into your composition and spray the erasure, FITS has added a new dimension to artistic creativity.

Safe at Any Speed

In a direct comparison with Adobe Photoshop 3.0, which also added both layering and layer transparency, the speed advantages that its IVUE technology brings to Live Picture are starkly apparent. Photoshop 3.0 uses a few tricks to speed up the way it displays layers, but its redrawing speed drops noticeably as you add layers. If your images are relatively small, and you have a lot of RAM in your Macintosh, then Photoshop may be a better choice than Live Picture. On the other hand, you will lose the unique creative features of Live Picture, such as the ability to air brush your effects.

About the Product

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Circle 1012 on Inquiry Card.

Live Picture worked well on my Power Mac 8100/80—almost too well. The editor, in fact, performed much faster than I needed. Screen redraws were so fast I found the machine pacing me; it was always finished with its work before I was ready to give it another command.

Several companies supply network-based FITS RIPs, but because even complex images are RIPed on the Power Mac in just a few minutes, I expect that it will run acceptably fast on a network. I did not test Live Picture on a network, however.

Live Picture 1.5 is not just another image-editing program. It can do things that no other editing program can. While its technical underpinnings (IVUE and FITS) are certainly innovative, I'll always value Live Picture for its easy-to-use special effects. The price may seem high to the amateur electronic artist, but it is a must-have for any professional. ■

Trevor Marshall is a BYTE consulting editor. He can be reached on the Internet at trevor@yarc.com or on BIX as tmarshall.

Apple's Workgroup Server 9150

BYTE peels the skin off another Apple—this time it's the high-end PowerPC-based Workgroup Server 9150

RAYMOND GA CÔTÉ

The Apple Workgroup Server 9150 is the high-end of a trio of PowerPC-based servers from Apple. All three systems are available with AppleShare 4.0.2 installed. Setting up the server consists solely of unpacking the system, plugging in the appropriate Ethernet converter (e.g., thin wire, twisted pair, or token ring), turning on the system, and entering the initial administration password.

A quick look at the system's capabilities and Apple's marketing literature would have you believing that the Server 9150 is a replacement for the previous high-end machine, the Workgroup Server 95. This is not the case. The Server 95 is a Unix-based 68040 system with a tuned version of AppleShare that takes advantage of the preemptive multitasking capabilities of Unix. Apple still intends the Server 95 to be the high-end choice for people who need maximum throughput in a file server.

The Server 9150's advantage over the Server 95 lies in pure computational speed. The system's 80-MHz CPU, 32-KB on-chip processor cache, and 512 KB of secondary cache combine to produce Apple's most computationally powerful system. All this power would be wasted if it were used simply to share files among users, so Apple has positioned the Server 9150 as an *application* server.

An application server provides access to computational services, rather than solely to shared files and raw data. A database server, which manipulates and filters large amounts of data before handing off the results to the client computer, is the traditional use for such servers. However, an application server can provide a variety of services, including automatic cataloging, prepress color separation, printing, and communications (fax).

System Specifics

The Server 9150 is housed in a full-size tower case. Around the back are two RCA-style phono connectors for stereo sound input, as well as the standard set of Macintosh connectors: monitor; Ethernet, SCSI, modem, and printer ports; a single Apple Desktop Bus port; and microphone and external speaker jacks. The high-speed GeoPort ports for a modem and printer are capable of maintaining 230.4-Kbps throughput.

The Server 9150 has two SCSI buses. All the internal SCSI devices are connected to the first SCSI bus; the second bus leads to both external and internal SCSI connectors. Removing the side cover of the Server 9150's case reveals a well-packed interior. Starting at the top are bays for as many as five 3½-inch drives. The standard configuration provides two 1-GB drives in the two lowest bays. The double-speed CD-ROM drive and tape backup DAT (digital audiotape) drive are mounted just above the drive bays. The review unit's single floppy drive is positioned about one-third of the way from the bottom of the case.

The Apple Workgroup Server 9150 provides bays for as many as five SCSI hard drives, a CD-ROM drive, and a DAT drive. A second, external SCSI bus lets you connect an additional seven hard drives outside the tower.

The power supply and fan consume about one-third of the central portion of the case. The primary cooling airflow starts at the back of the case, is pulled through the tightly packed drive bay, over the eight memory slots, and then out through the power supply. A second, smaller flow of air comes in over the four NuBus expansion slots. Significantly, the PowerPC processor itself is not in the direct path of either air current; the chip runs cool enough to get by with just a heat sink.

Reaching the hard drives is a simple matter of removing a few screws and sliding out the mounting bracket. The NuBus expansion area is also readily accessible, as is the single PDS (Processor Direct Slot) located adjacent to the NuBus connectors. For some reason, though, Apple has a habit of blocking access to RAM slots. In this case, the RAM expansion slots reside just behind the edge of the power supply. You might be tempted to try wedging your hands in there, but, given the cost and fragility of memory, you are better off removing the power supply to get at the slots. Of course, you must remove the drive bays before you can remove the power supply. The placement of the internal connector for the second SCSI bus behind the power supply presents one further hassle.

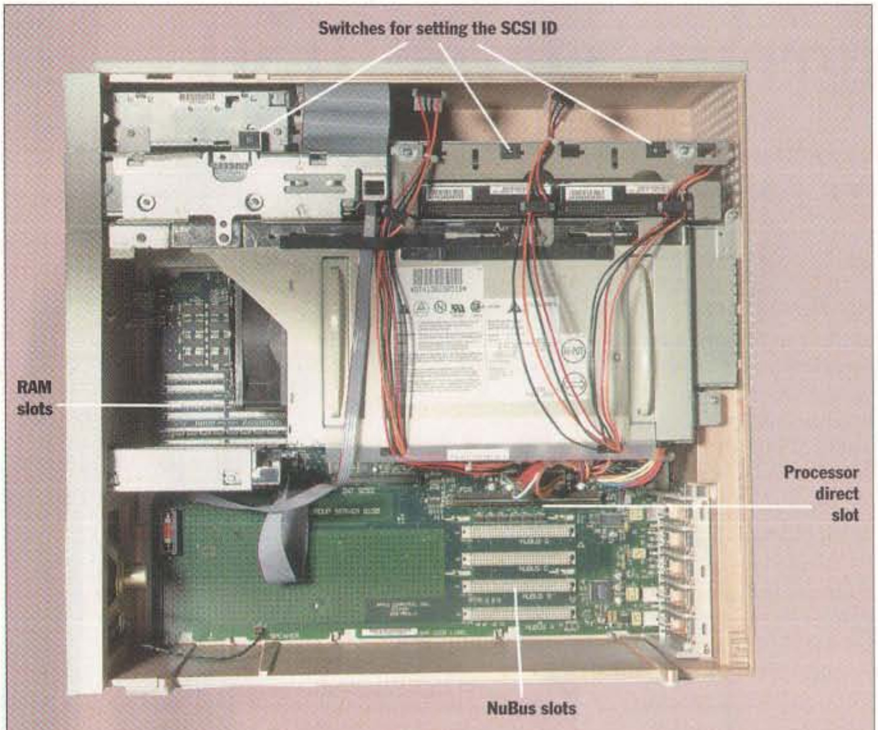
System Software

The Server 9150 runs the standard PowerPC version of System 7 release 7.2; you may have AppleShare 4.0.2 installed at the factory. A PowerPC version of Retrospect Remote provides archival backup on the DAT drive.

Apple is promising a software-only version of RAID that provides RAID 0 (disk mirroring) and RAID 1 (disk striping) and should offer additional improvements in performance or data integrity. This software was not available at the time the tests were conducted.

The Test Applications

Because Apple has positioned the Server 9150 as an application server rather than a file server, I concentrated on evaluating the speed of the available native-mode applications. Over a dozen companies have



The Workgroup Server 9150's internal layout allows quick and easy access to drives and the NuBus expansion area, but the RAM expansion slots are hidden behind the power supply, which you must remove when adding more memory to the base system.

announced the release or imminent release of applications that take advantage of the Server 9150. These include such diverse applications as 4D Server, a new multiuser release of the 4th Dimension database; a work-flow server from Quark; and an automated software distribution system from Wave Research.

For these tests, I ran several applications that are available for both 68K-based processors and PowerPCs. I also ran preliminary versions of the new BYTE cross-platform benchmarks. The test 68K server was a 33-MHz Workgroup Server 80 with 8 MB of RAM and a 1-GB hard drive running System 7.1. The Server 9150 had 16 MB of RAM and two 1-GB hard drives. The table "Performance Results" summarizes the test results. I used the following products during testing:

- A beta version of ACI US's 4D Server, a native PowerPC version of the standard 4th Dimension 68K server. Although informal testing indicated that the PowerPC version is, not surprisingly, significantly faster than the 68K version, the final numbers are not included in the results, because, at test time, the software was still in beta form. 4D Server should be shipping by the time you read this review.
- Cumulus PowerPro, an image-cataloging and -retrieval system from Canto Software. The server can create or extract thumbnails from almost any image format. It combines a clean, simple user interface with a quick search engine, a hierarchical keyword structure, and a drag-and-drop interface. Cumulus PowerPro also lets you print selected images directly from the server. During testing, I loaded and cataloged the same 1289 images on the 68K version and the PowerPC version. The 68K version needed an average of 5.7 seconds per image. The PowerPC version required 2.4 seconds per image—a performance increase of 133 percent.
- Filemaker Pro from Claris, a popular Macintosh database system. Although it has long provided the ability for multiple users to access a single database via a network, earlier implementations were slow and moved lots of data over the wire. Claris has introduced a server version of the product, which, combined with Filemaker 2.1v3, provides greatly enhanced multiuser access. As many as 100 users can connect to a server simultaneously. More important, sorts and searches can now take place on the server; before, the client did much of the work.

The first Filemaker benchmark test was a multifield search of a 32-MB file (the maximum file size allowed) containing 2068 records. The 68K-based Server 80 completed the test in 8 seconds, while the Server 9150 crossed the finish line in 5 seconds. A second test required obtaining a grand total of a series of floating-point numbers in the 2068 records. The Server 80 completed this task in 87 seconds, and the Server 9150 required 52 seconds. For these two tasks, the Server 9150 was at least 60 percent quicker than the Server 80.

The last series of tests consisted of running a late-beta version of BYTE's new cross-platform benchmarks. These new benchmarks test simple algorithmic operations, such as sorting numbers and strings, and evaluate real-world performance with such tests as a Fourier transform and a neural network back-propagation routine. The results varied widely, with one test actually showing a decrease in performance on the Server 9150, while solving a linear-equation algorithm improved by a factor of 13. Although speed improvements are always dependent on the application that you use, the approximately 400 percent overall improvement shown in these tests indicates that native

About the Products

Workgroup Server 9150 (with an 80-MHz PowerPC 601, 512 KB of secondary processor cache, 16 MB of RAM, two 1-GB hard drives, a DAT drive, a CD-ROM drive, Retrospect Remote backup software, and RAID software)......$9229
(with AppleShare 4.0.2 installed)..........$10,269

Workgroup Server 8150 (with an 80-MHz PowerPC 601 processor, 256 KB of secondary processor cache, 16 MB of RAM, Ethernet, a double-speed CD-ROM drive, room for a single 1-GB hard drive, an internal DDS-2 DAT drive, and one SCSI bus)..................$7459
(with AppleShare 4.0.2 installed)............$8499

Workgroup Server 6150 (with a 60-MHz PowerPC 601 processor, 256 KB of second-level processor cache, 8 MB of RAM, Ethernet, an internal 500-MB hard drive, a double-speed CD-ROM drive, a floppy drive, and AppleShare 4.0.2 installed)..$4219

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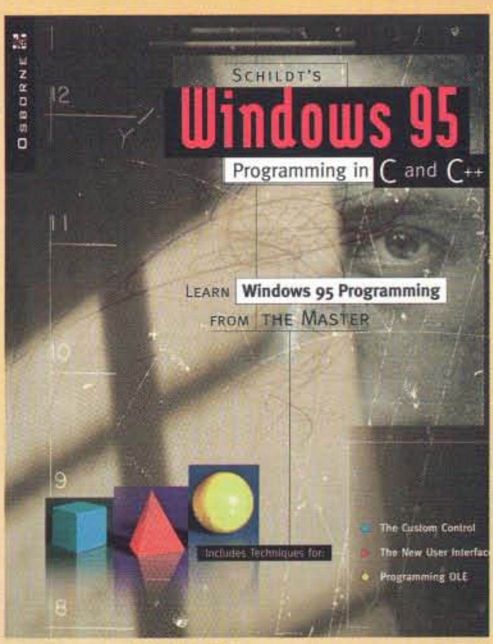

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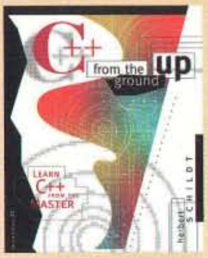

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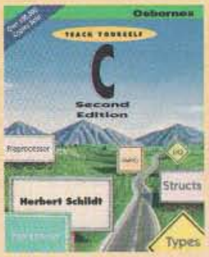

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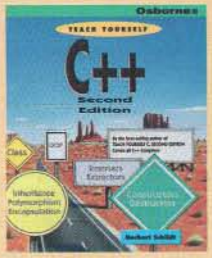

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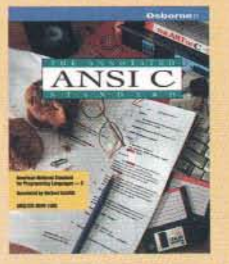

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PERFORMANCE RESULTS

These results show the relative speed increase provided by the PowerPC 601-based Workgroup Server 9150 over the Motorola 68K-based Workgroup Server 80. Figures include relative speed ratings for both applications and benchmark tests. The BYTE benchmark integer index figure is the geometric mean of the following tests: numeric sort, string sort, bit-field operations, floating-point emulation, assignment algorithm, IDEA (International Data Encryption Algorithm), and Huffman compression. The floating-point index figure is the geometric mean of the Fourier coefficients calculation, neural network simulation, and LUD (lower and upper decomposition). The tests were compiled using Metrowerks Code Warrior CW4.

The BYTE tests are beta versions, and the results are therefore preliminary. If BYTE finds a significant change between these results and those obtained when the benchmarks are in their final form, the magazine will publish an update.

TEST	PERFORMANCE INCREASE*
Filemaker search	1.6
Filemaker summation	1.7
Canto image cataloging	2.4

BYTE BENCHMARKS

	68K-BASED WORKGROUP SERVER 80 INDEX	POWERPC-BASED WORKGROUP SERVER 9150 INDEX
Integer	.22	.77
Floating-point	.04	.22

* Figures indicate the performance increase of the Workgroup Server 9150 over the Workgroup Server 80.

applications will get a significant boost on the Server 9150.

The PowerPC Today

Apple has significantly raised the performance of its server offerings with the introduction of its PowerPC 601-based workgroup servers, such as the Server 9150. Although bigger and quicker machines are always promised in the near future, the performance increase offered by the Server 9150 over previous 68K-based servers provides good reason to select a PowerPC solution today. Apple's top-of-the-line PowerPC platform is a solid powerhouse ready to perform immediately. ■

Raymond GA Côté is a BYTE consulting editor and vice president of product development for Appropriate Solutions, Inc. (Peterborough, NH). You can reach him on the Internet at rgacote@apsol.com or on BIX as "rgacote."

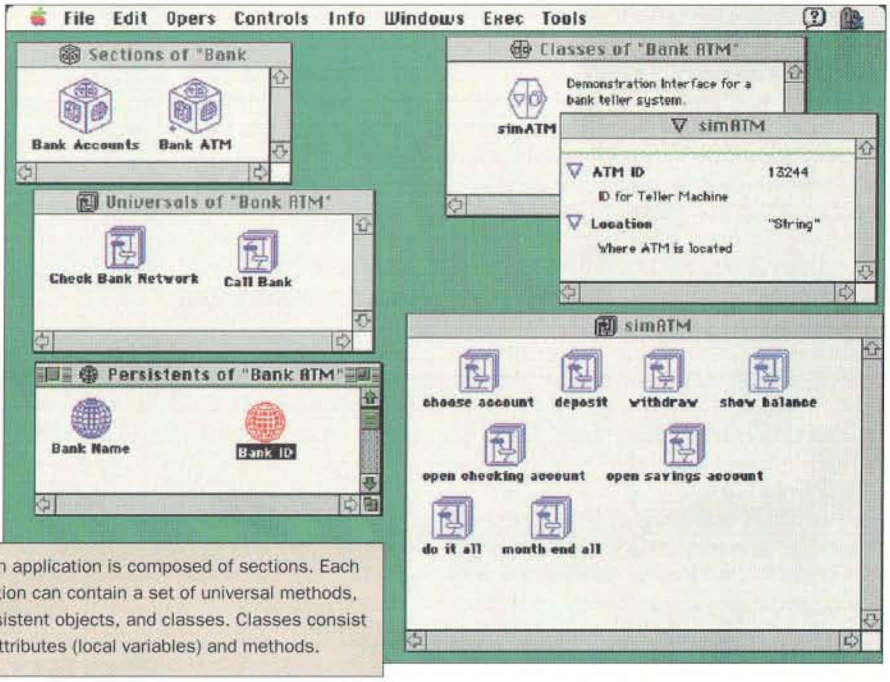
Prograph CPX: Purely Visual

Visual programming to the extreme: no hand-typed code, no waiting

RAYMOND GA CÔTÉ

Prograph CPX from Prograph International of Halifax, Nova Scotia, is a pictorial development environment and application framework for the Macintosh. It supports custom extensions and provides optional support for communicating with corporate databases. The Prograph environment consists of several major subsystems: an interpretive development environment and debugger, an ABC (Application Builder Class) framework, and a separate compiler for creating stand-alone executables.

Prograph is object-oriented and data-flow driven, with a dynamic development environment. The publishers claim it will slash hundreds of hours off your development time. And it will soon be available on platforms other than the Macintosh (see the text box "Crossing Platforms"). This product sure has all the right buzzwords, but can it deliver on its promises?



Demonstration Interface for a bank teller system.

ATM ID 13244
ID for Teller Machine
Location "String"
Where ATM is located

Each application is composed of sections. Each section can contain a set of universal methods, persistent objects, and classes. Classes consist of attributes (local variables) and methods.

What a Pretty OODL

Object-oriented programming is such a common concept these days that I won't belabor the point except to say that Prograph, like SmallTalk, really *is* object-oriented. Everything is an object. This provides a great deal of flexibility, such as the ability to identify object types at run time and make decisions based on the type.

Such a true object-oriented approach has the potential of adding significant processing overhead to any application. In practical terms, this does not seem to be a major liability on modern machines. I ran the Prograph development environment on a Macintosh 9150 Power PC Workgroup Server, a PowerBook 540, and an old Macintosh IIci. Although the interpretive development environment can be a bit sluggish at times, the final compiled executables run satisfactorily.

The concept of a dynamic development environment is not new—SmallTalk being the classic example—but it is still fairly rare. In a dynamic development environment, everything, including the executing program, is available for examination and modification. This means that you can take an application and change its underlying code, window layouts, and even class hierarchies while the program is executing and immediately see how the changes alter the program's behavior.

If the integrated debugger pops up with an error, you can examine the problem, modify or rewrite the method exhibiting the problem, and then continue execution starting from where your changes alter the possible flow of execution. You can even write your programs in a top-down fashion without defining the lower levels of functionality until the program is running. The debugger simply states that you are accessing a method or attribute that has not yet been defined and asks if you want to define it now.

Where Has All the Data Gone?

Perhaps one of the most difficult concepts to grasp in Prograph is that the basic program execution follows a data-flow model. Data-flow languages provide little control over the order in which sections of a program are executed. And, truth be told, you usually don't care about the execution order. If a low-level primitive requires three parameters, the primitive executes as soon as the three parameters are available, regardless of what else needs to be completed. Although this concept is fairly foreign to most C and C++ programmers, it is a convenient way of envisioning program execution. Simply take a piece of data and follow it around your program.

In real-world applications, some operations must take place in a specific order (e.g., update a database entry before reading it from another part of the program), and Prograph imposes execution order through the use of *synchro* links. But even with synchro links, Prograph does not guarantee that one operation will occur immediately after another, only that the second operation will occur after the first.

Although this is the first data-flow language I've used, I became comfortable with thinking in terms of data flow after a day or two of using Prograph. You'll probably find the data-flow concept easier to grasp than your first attempts at learning C++.

Who Needs Pictures?

The overwhelming first impression of Prograph is that of either a CASE or a drawing tool. Everything is visual. Projects are composed of sections, which are composed of universal procedures, persistent data objects, and methods (see the screen above). Methods, in turn, are composed

Prograph CPX: Purely Visual

of cases, which, in turn, contain the actual code (see the screen on the right). All the elements at each level are represented by pictures. At no point in Prograph will you open up a large text window and start writing the "real" code. The real code is created by placing a set of built-in (or user-defined) primitives onto a methods window and then drawing lines to link these pictures together to form a program.

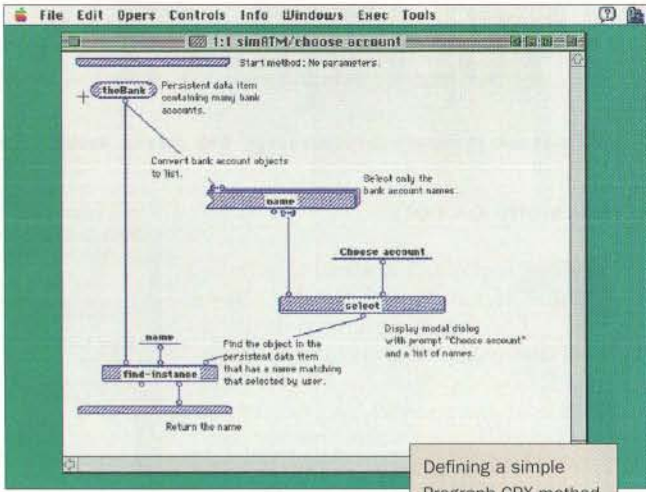
Being from the old school of programming (I'll happily regale you with tales of paper tape and punch cards), this is about as far removed from traditional programming as I can get. Where's the text? How do I see the overall program flow? And how does all this picture stuff work, anyway? Don't assume that just because Prograph is based entirely on pictures that it is simple, intuitive, or a toy; it is none of these. What it is, is consistent, powerful, and expressive.

Over the years, I have tried a number of picture-based development environments and CASE tools, many of which claimed they would simplify my development environment. Many of these tools were just collections of pretty icons that contained ordinary traditional code. Prograph is different from any other tool I've used. It provides a language as rich and complex as SmallTalk or C++ but in pictures, not words.

Drawing on Experience

The first thing you must do after installing Prograph is work through the tutorial. Otherwise, you'll just be frustrated by the experience. Prograph is loaded with options. You can click, double-click, command-click, and option-drag command-click to perform an operation. Clicking on the left or right side of an icon produces different actions. There are even multiple controls with various options tucked into the title bar of several windows.

It sounds complicated when you first read through it, and indeed, it remains so for the first few hours. You'll quickly find, however, that what Prograph lacks in simplicity it makes up for in consistency. Command-clicking always performs the same type of action, as does double-clicking the left side versus the right side of an icon (the left side creates things, and the right side provides a list of preexisting things, such as methods).



Start method: No parameters.

Persistent data item containing many bank accounts.

Convert bank account objects to list.

Select only the bank account names.

Display modal dialog with prompt "Choose account" and a list of names.

Find the object in the persistent data item that has a name matching that selected by user.

Return the name

Defining a simple Prograph CPX method visually.

Intuitive is probably the last word I would choose to describe Prograph. Without the tutorial, you'll never be able to figure out how to perform even the simplest operations. This is not a criticism of the product. After all, how intuitive did you find C or C++ to be the first time you tried to learn it?

Prograph is a complex and powerful tool that requires a serious investment in time and effort. After working with Prograph for about a week, I feel comfortable building some simple one- and two-window forms and working with some databases. It will probably take another two or three weeks before I can stop referring to the reference guide every 5 minutes. However, three to four weeks to become comfortable with a new language is not a large investment of time.

Learning ABC

No development environment today is complete without its own class library or framework. Prograph provides the ABCs and ABEs (Application Builder Editors). Every application contains a single instance of the application class. Applications, in turn, are composed of menu, window, and document classes.

Building the user interface consists of creating a set of menus and windows, associating behaviors with the menu items and the window control elements. You can define behaviors for each event that is appropriate for a particular control item (e.g., double-click, key-down, update, and others). The object editors also let you

Crossing Platforms

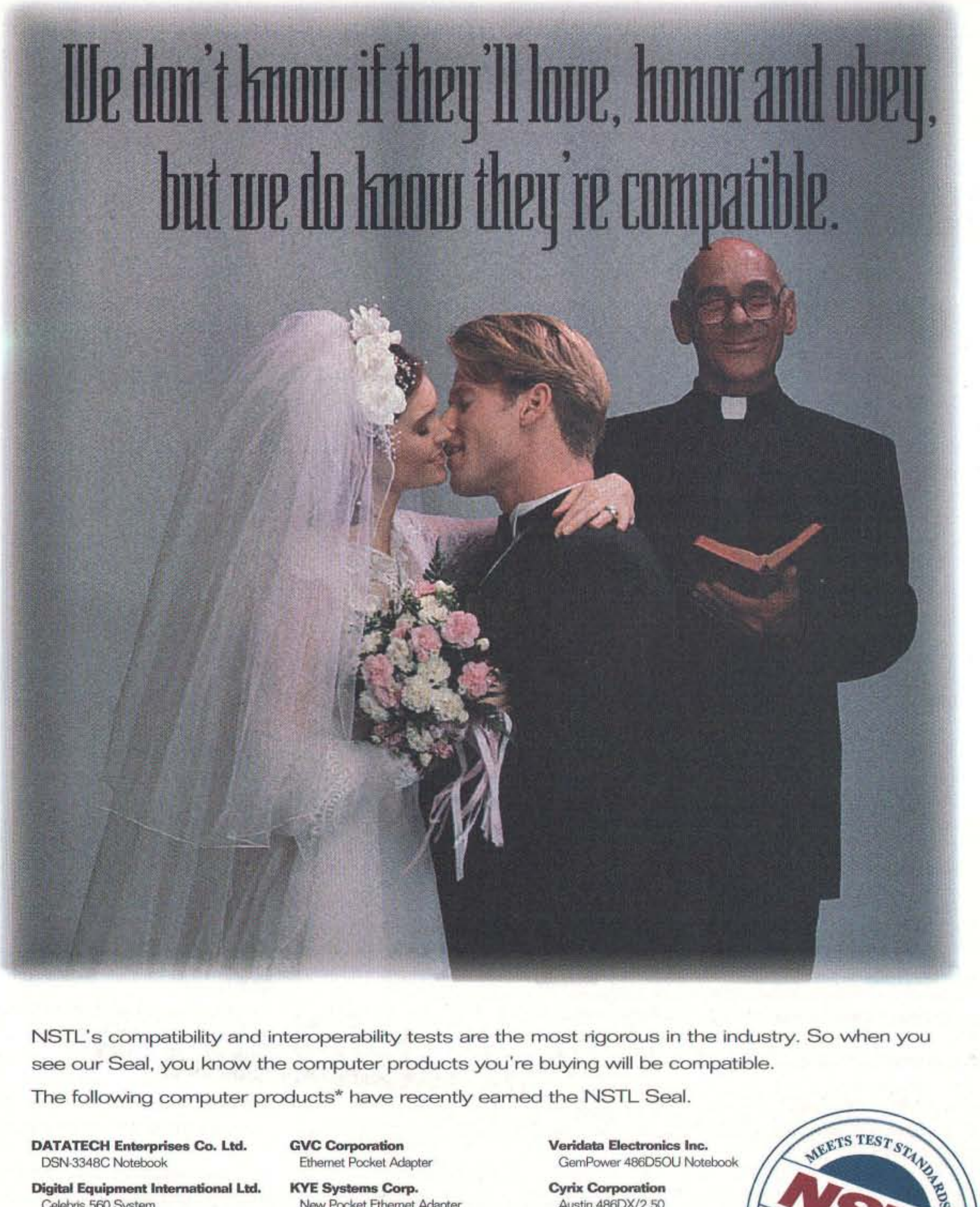
As a professional software developer, I find it difficult to recommend any software development tool that is not available on more than one major computing platform. Although Prograph CPX has a 1.0 release number on it, Prograph has been available on the Macintosh for several years. Now, with its "professional" version, Prograph International is prepared to move off the Macintosh.

According to product manager Mark Szpakowski, Prograph will be shipped for the Windows platform during the first quarter of 1995. A Unix version is also in the works, but exact release dates are not yet available. A Power Macintosh version should be available by the time you read this.

Prograph is a 32-bit development system and will require a 32-bit operating system for developing and running the final executable. The initial target development environment will be Windows NT and Windows 95 when it is available. The programs you create with Prograph will also be able to run under Windows 3.1 with the Win 32s extensions.

Prograph International appears to be taking a reasonable approach to cross-platform compatibility. It is not attempting to maintain 100 percent compatibility with the low-level Macintosh-style calls in the current Prograph. Rather, the compatibility level is focused on the ABC class library and as many of the lower-level Prograph primitives as make sense. A platform-specific layer of primitives will provide full access to the Windows API, just as Macintosh users have full access to the Mac Toolbox.

Mr. Szpakowski notes that Prograph's built-in database capability will be available across platforms, with the ability of sharing the resulting files among Mac, Windows, and Unix applications. In addition, access to external database systems through ODBC (Open Database Connectivity) will be identical on the Mac and under Windows.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define Balloon Help text items.

Editors are provided for each of the control item types. You can define new editor types for new controls. The tutorial shows how to define a new chart control that has its own editor.

The ABC library is rich and expressive; aside from the usual window and menu control elements you expect to see in any framework, you'll also find classes for printing, delayed tasks, font control, color and image manipulation, database access, image dragging, and rubber banding. The interactive development environment was built using the ABC library and is an excellent demonstration of the library's capabilities.

At the other extreme to the ABC library is the set of medium- and low-level primitives. Here you'll find functionality from simple bit and string manipulations to serial-port control, AppleEvent interfaces, AppleTalk, QuickTime, and a full set of Macintosh Toolbox primitives up through System 7.1. Using the built-in extension capability, it is fairly easy to add support for new Toolbox functionality, such as the Drag and Drop or Speech managers available in System 7.5.

Extensibility

One problem with nonmainstream development environments is determining what to do with all your old code. Prograph provides two solutions to this problem. You can create new primitive functions, or you can simply treat your old code as an extension.

Creating a new primitive requires you to take the existing source code and encapsulate it in a wrapper that provides access to the Prograph internal structures, such as objects, strings, and lists. Primitives can also communicate with the interpretive environment to provide error conditions.

Most of the primitives provided in the Prograph environment are written in Symantec C. Primitives can be written using either Symantec's Think or Apple's MPW C compilers. Sample MPW and Symantec projects are provided, which you can modify to fit your own needs. Writing new primitives may require you to significantly alter your existing code to take full advantage of the Prograph structures, but it provides the tightest coupling of the environment with your old code.

Extensions are useful for including large amounts of existing C or Pascal code in your Prograph environment. To create an extension, you first create a standard Symantec Think or MPW code library. You then run this library through the C or Pascal Interface Tool for Prograph to produce a package. You copy the package into an Extensions folder on the Macintosh, where it is immediately available for use within Prograph. Although Extensions are not as tightly integrated into the Prograph development environment as Primitives (e.g., you would not use Prograph native data structures), they are a quick and convenient way to gain access to lots of existing code.

Building Applications

Prograph ships with both an interpreter and a compiler. After your final application is developed and debugged in the Interpretive environment, you start up the compiler to create the final double-clickable application.

The compiler has a minimal interface. Beyond letting you set some application specifics—the Finder ID, heap size, and various system flags—it simply compiles the application. If the compiler finds an error, such as an undefined method, it flags the error and provides you with the option of switching to the interpreter environment to fix the problem. Be prepared with lots of RAM if you have both the compiler and interpreter running at the same time—each requires about 7 MB.

The resulting applications run noticeably quicker than in the interpretive environment. They are also significantly smaller. Whereas the development environment requires about 7 MB, the smallest application size appears to be around 512 KB when using the ABC framework. One sample program that manipulates images, performs database access, and provides several data-entry screens required around 700 KB and took 4.5 minutes to build. As with most frameworks, the resulting executables seem too large for small, frequently used utilities. However, the 500-KB executable size is comparable to other frameworks.

Conclusion

Prograph CPX is a rich and powerful development environment. Once you become familiar with the system, its three-layered approach of framework, rich primitive set, and comprehensive set of low-level Toolbox calls provides the unbeatable expressive power of an abstract framework with the functionality of direct communication with the operating system.

Coupled with the interpretive development environment, this extensibility lets you quickly develop sophisticated applications. The major drawback to this environment is its availability on only a single platform, but that should be changing soon. ■

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About the Products

Prograph CPX *(includes 90 days of free technical support)*	$695
Interapplication Communications Toolkit	$99
Charting Objects	$99
Visual Effects Manager	$149
C Tool (for creating extensions)	$199
Communications Toolbox	$299
SQL/DAL interface *(includes 10 deployment seats; >10: $75 per seat)*	$999
Oracle interface *(includes 10 deployment seats; >10: $75 per seat)*	$999
Sybase interface *(includes 10 deployment seats; >10: $75 per seat)*	$999
SNA gateway *(> 50 seats: $100 per seat)*	$9950
PDN (Prograph Developer Network) *(subscription includes three CDs per year plus technical support)*	
PDN/Bronze E-mail support	$399 per year
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Powerful Presentations for Windows

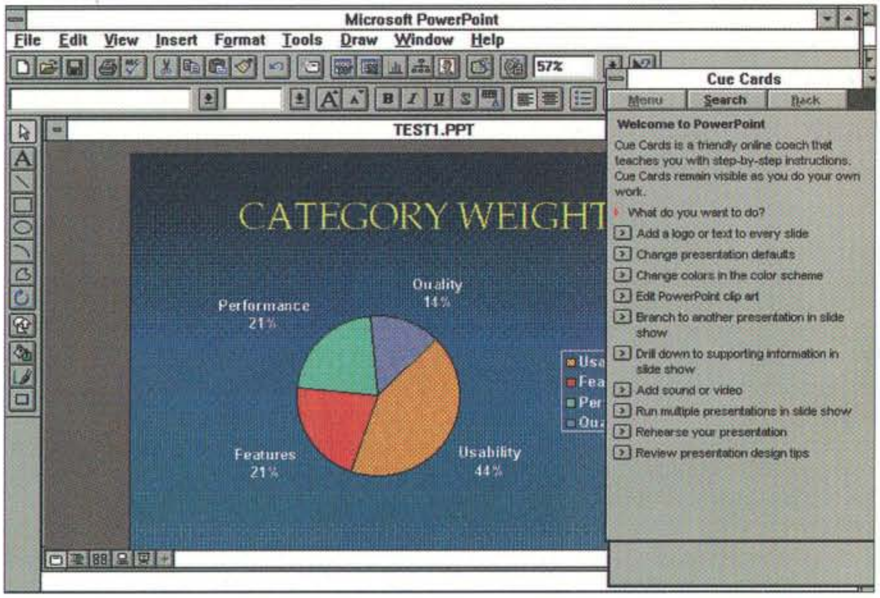
The top presentation programs for Windows concentrate on usability, but there's plenty of power under the hood

SUSAN YEATON

Presentation packages help business presenters to create what was once the province of corporate art departments and outside consulting firms: professional-looking overheads, slides, handouts, and screen shows. Whether the program is used twice a year or once a week, time not spent on choosing complementary colors and aligning text can be spent on a presentation's content. Thus, the trend has been for these programs to stress usability features and make design choices for the user.

This month, NSTL focuses on Windows presentation packages that fit the general-business-use category—Charisma, Harvard Graphics, Lotus Freelance Graphics, and Microsoft PowerPoint—rather than those that emphasize multimedia presentations. To fit this category, the programs must be broad-based, with extensive charting (including organization charts), drawing capabilities, a built-in outliner that accepts text created in other programs and retains the outline levels of that text, and slide-show features.

NSTL did not include programs, such as Astound and Action, that appeal to the high-end multimedia user, because these programs are best compared in an issue dedicated to multimedia. For the same reason, NSTL did not include programs that emphasize drawing (e.g., CorelDraw) or charting (e.g., Stanford Graphics and DeltaGraph Professional). Also, the point upgrade of Asymetrix's Compel still lacks an outliner and does not provide the extensive charting of the other programs chosen for this review.



Welcome to PowerPoint

Cue Cards is a friendly online coach that teaches you with step-by-step instructions. Cue Cards remain visible as you do your own work.

What do you want to do?

- Add a logo or text to every slide
- Change presentation defaults
- Change colors in the color scheme
- Edit PowerPoint clip art
- Branch to another presentation in slide show
- Drill down to supporting information in slide show
- Add sound or video
- Run multiple presentations in slide show
- Rehearse your presentation
- Review presentation design tips

NSTL recommends Microsoft PowerPoint as the best all-around Windows presentation program. It's the easiest to learn and use, has the best quality, is fast, and has an extensive array of features.

Focus on Usability

Because less technical users are often required to build presentations, usability is an important component of this evaluation. To test usability, NSTL convened a panel of independent testers who were not familiar with the programs and asked them to create and give a presentation that included several text charts, data charts, an organization chart, and clip art. They used each program's outliner and added transition effects to an on-screen presentation. Testers ran tutorials, consulted manuals and on-line help, and used the learning and use aids provided by the programs.

Creating pages, or *slides*, is the core of the presentation process. The testers created a seven-slide presentation, with a variety of bullet, title, and data charts, and with clip art. They used both the outliner and the slide editor to build the presentation. After creating the entire presentation, the testers switched templates and concentrated on making edits to the slides.

All the programs have templates (also known as backgrounds or masters), which are basically slide backgrounds with a particular "look." Color templates contain complementary colors that let you create professional-looking slides with no effort. You can alter templates to fit individual

OVERVIEW

NSTL RATING		VERSION	PERFORMANCE	VERSATILITY	EASE OF LEARNING	EASE OF USE	REQUIRED MEMORY	PRICE
★★★	Charisma	4.0	▼	▲	▲	▲	4 MB	$495
★★★★	Harvard Graphics	3.0	▼	▲	▲	▲	4 MB	$395
★★★★	Lotus Freelance Graphics	2.1	▲	▲	▲	▲	4 MB	$495
★★★★	Microsoft PowerPoint	4.0	▲	▲	▲	▲	8 MB	$395

KEY

★★★★★	Outstanding
★★★★	Excellent
★★★	Average
★★	Below average
★	Poor
▲	Good
■	Fair
▼	Unacceptable

PERFORMANCE
All times are in seconds.

	CHARISMA 4.0	HARVARD GRAPHICS 3.0	LOTUS FREELANCE GRAPHICS 2.1	MICROSOFT POWERPOINT 4.0
Print black-and-white handouts				
Return-of-control	17.8	25.4	17.6	11.3
Page drop	117.1	154.3	162.7	95.3
Screen redraw				
Switch to gradient background	8.4	2.8	1.0	15.8
Go to next slide	8.7	10.8	7.2	7.6
Switch views				
To sorter	13.7	13.9	8.4	1.0
Back	0.8	2.8	0.3	0.8
Print color handouts				
Return-of-control	20.8	28.8	18.0	12.9
Page drop	572.3	466.0	527.8	446.4

needs and save them for future use.

Charisma asks you to choose the output medium to determine page size and orientation and appears to offer the same template list despite the device that you choose. Harvard Graphics lets you pick any template regardless of the chosen output device but gives hints about which ones work best in each medium. The same Freelance Graphics template can be used regardless of the output medium (e.g., overhead, 35mm slide, or screen show), and the program will make the necessary adjustments to the slides. PowerPoint, on the other hand, separates its templates by output device.

Templates and the adoption of "click here" prompts by all the tested programs eliminate the need for drawing placeholder boxes and take the guesswork out of creating a presentation with a cohesive look. Where the prompts appear on a given slide is governed by the page layout chosen. Now offered by all the programs, page layouts let you choose the type of slide you want (e.g., a title page, a bullet chart, or a pie chart). More-complex layouts include two-column bullet charts and combination text and data-chart layouts.

Electronic Consultants

Even with dozens of attractive templates and great page layouts, you sometimes need help organizing your thoughts and figuring out which type of chart is best for the job. Harvard Graphics' and PowerPoint's new advisors and wizards are intended to get you by the impasse. PowerPoint's AutoContent Wizard leads you through a choice of six common types of presentations (e.g., recommending a strategy or selling a product or idea). By choosing one and filling in some simple information, such as a slide title and name, it becomes a presentation in outline form with several slides created. You then replace the hints with your own text, and you have generated a presentation.

Harvard Graphics' Quick Presentations feature also starts with a sample presentation based on one of seven themes, such as a marketing plan or a new-product proposal. You just pick a theme, and the slides are created, complete with titles, bullets, and charts. Unfortunately, the text is often too vague or short (e.g., "Marketing Mix"), with no further information given.

Harvard Graphics' Quick Advice system, however, is excellent. In the dialog box for a new presentation, you not only can choose your template, layout, and output device, but you can receive helpful information on each possible choice, along with a thumbnail preview of each. For example, if you choose a scatter chart, the advisor explains when to use a scatter chart and then describes and explains the options available for each type of scatter chart. Best of all is the advisor that describes each template and includes a thumbnail of it next to its description.

Freelance Graphics' point release lacks the advanced help features offered by Harvard Graphics and PowerPoint. Creating a presentation requires dealing with two simple dialog boxes: one for choosing a look, with thumbnails and names of each template (SmartMaster), and one for choosing a page layout. Freelance Graphics has an excellent option for previewing each slide edit before you invoke a change. You can also preview changes to text attributes and charts, which can be a great aid to productivity. Moving or resizing Freelance Graphics' "click here" prompts can affect all slides with the same page layout at once, or you can first unlink the edited slide so that changes affect only that slide.

Charisma does less hand-holding than Harvard Graphics or PowerPoint in creating a presentation, so it's a bit difficult for a nonprofessional to use. As with Freelance Graphics, you pick a template and a page layout from the list and thumbnail, and the thumbnail is drawn with the background you just selected. Once you choose these items, hints that are displayed on the status bar provide some guidance for working

Highlights

	Strengths	Limitations
Charisma	Special drawing effects Only program with Gantt chart feature Only TWAIN-compliant program	Most difficult to learn and use Limited workgroup features No organization chart feature
Harvard Graphics	Great advisor help system Conferencing feature Extensive drawing effects with bundled Harvard F/X	Slowest program overall Lowest quality rating overall Smallest number of templates and clip-art library
Lotus Freelance Graphics	Fast screen redraws Largest number of templates and transition effects Only program with automatic file backup	Smallest number of outline levels No custom chart templates Restricted placement of chart legends and titles
Microsoft Powerpoint	Fastest program overall Highest quality score overall Only program with screen-show rehearsal feature	One-level Undo feature Cannot choose second color for gradient Cannot have multiple pies on one chart

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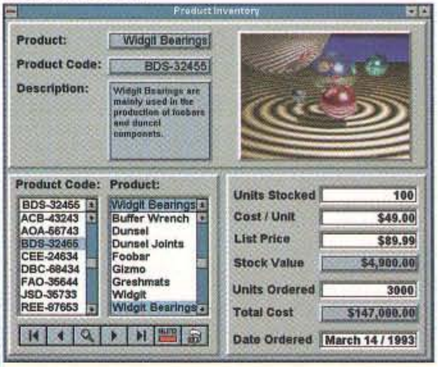

Product: Widgit Bearings
Product Code: BDS-32455
Description: Widgit Bearings are mainly used in the production of foobars and duncel components.

Product Code:	Product:
BDS-32455	Widgit Bearings
ACB-43243	Buffer Wrench
AOA-66743	Dunsel
BDS-32465	Dunsel Joints
CEE-24634	Foobar
DBC-68434	Gizmo
FAO-35644	Greshmats
JSD-35733	Widgit
REE-67653	Widgit Bearings

Units Stocked: 100
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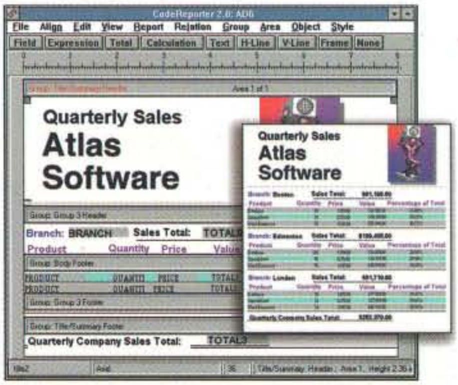
CodeReporter 2.0: AD6
File Align Edit View Report Relation Group Area Object Style
Field Expression Total Calculation Text H-Line V-Line Frame None
Area 1 of 1
Group: Group 3 Header
Group: Body Footer
Group: Group 3 Footer
Group: Title/Summary Footer

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Circle 115 on Inquiry Card.

on the slide, such as "Enter Text" when you double click on a text box and "Drag to move symbol" when you select any placeholder or object. The testers found Charisma hard to learn and sometimes cumbersome when making changes to slides. Using edit commands, such as changing bullet attributes, is somewhat confusing, as is building slides via layers.

On-Screen

All the programs simplify the procedure of setting up and running a screen show. They differ slightly, however, in the way they apply transition effects and offer some distinct features.

PowerPoint is the easiest program to use for presenting a screen show with little or no multimedia objects. You can set the speed of transition effects to slow, medium, or fast. Because you preview effects right on the slide-sorter thumbnail, you can directly see how the effects will look on your slides. You can preview effects on a sample slide in a dialog box as well. PowerPoint is the only program that lets you rehearse your presentation to judge how long you spend talking about each slide and the whole show.

PowerPoint also has a "drill down" feature that lets you embed another document (e.g., a spreadsheet) in a presentation so that backup data is available at a moment's notice if you need it. You can access the data easily during the presentation by clicking an icon placed on the slide. With data links, you can change the backup data, which will update a linked chart on the slide as well.

The other programs receive the same ratings for screen presentations. They all work fairly easily, but they do not have PowerPoint's overall usability. You should note, though, that Charisma has great dialog boxes for adding movies and sound to presentations and has effects choices on an icon bar. As with PowerPoint, you can set the speed of transition effects. Printed output in all the programs includes audience handouts, speaker notes, full-size slides, and, with the exception of Harvard Graphics, outlines.

The Drawing Board

Drawing is a feature that is strongest in Charisma and Harvard Graphics. Charisma's tools are part of the interface, but Harvard Graphics' are primarily in Harvard F/X, an integrated application packaged with the main program. Harvard F/X has a different interface that takes some time to get used to, but it has eye-catching effects. Harvard F/X and Charisma offer curved, warped, and extruded text and objects; PowerPoint can apply these effects to text only via Microsoft WordArt. Charisma and Harvard F/X let you contour text to a path and blend objects, a capability of Freelance Graphics as well. Harvard F/X

In the Wings

PERSUASION 3.0

Although it was not ready in time for full NSTL testing, the long-awaited version 3.0 of Aldus's Persuasion will soon be available, bringing another strong challenger into the field of desktop presentation packages. The new version of Persuasion continues the program's strategy of focusing more on serious users who will be creating presentations on an on-going and fairly frequent basis. It makes great strides in adding usability to the program through a revamped and more logical menu structure and floating icon palettes, but high-end features are the priority. In fact, Persuasion lacks novice-level teaching tools. The program does not include any wizards, coaches, or advisors.

Persuasion is a powerful program that provides many fine-tuning controls that appeal to serious presentation designers. You can adjust the position of graphics objects, for example, by increments as small as the width of one pixel on the screen using "nudge," a feature also found in Microsoft PowerPoint 4.0. You can adjust independently the foreground, background, line, and shadow colors of each graphics object or piece of text to any of 200 colors or any of 200 gray scales. And you can define an unlimited number of left-, right-, center-, and decimal-aligned tabs for each text group you add to a page.

The biggest advance is the addition of Aldus Chart 1.0, the companion charting program. It adds histograms, bubble charts, radar charts, polar charts, high-low-open-close charts, and spectral area maps to its standard stock of chart types. Two other notable feature additions to Persuasion are animation and hyperlinks within its slide shows. Either can be used by the main program as well as by the run-time slide-show player.

WORDPERFECT PRESENTATIONS FOR WINDOWS 3.0

We could not include WordPerfect Presentations 3.0 in our full report, but we did preview a beta version of the program. Presentations will compete on its own but will also be part of the upcoming PerfectOffice suite of applications. All the modules in the PerfectOffice suite feature a common menu structure between the modules and shared resources, such as the spelling checker, thesaurus, grammar checker, and drawing tools. The suite also supports cross-application macros.

Presentations has an extensive list of features. Particularly impressive are its tools for painting and bit-map editing directly on slides. TWAIN support lets you scan images directly into the program.

Another area where Presentations is strong is in 3-D effects. The program comes with an impressive set of tools that can add all kinds of 3-D effects to either charts or text. You can, for example, give text a straight 3-D, perspective 3-D, or reverse perspective 3-D aspect, all from many viewpoint angles. You can also give 3-D aspects to charts at any time from any viewpoint angle.

Presentations offers numerous tools designed to shorten the learning curve for first-time users. It includes a series of coaches, which are short tutorials related to specific presentation-building tasks. One particular feature that should make Presentations faster and easier to work with is its in-place editing of data charts. The program also includes another learning tool (similar in concept to PowerPoint's wizards and Harvard Graphics' advisor system) called the Show Expert, which teaches you how to design a presentation.

also makes circular or rectangular copies of objects and will meld, intersect, subtract, or punch objects' paths.

Also worth noting is Harvard Graphics' Conferencing feature, which lets you display a presentation simultaneously on up to 64 computers connected via a NetBIOS-compatible LAN. During a conference, the presenter controls the mouse and slide changes, although control can be given to an attendee. Freelance Graphics and PowerPoint support Lotus Notes, which lets a presentation be routed to workgroup members for review and editing.

Presentation Performance

Creating a presentation with a polished, professional look and attention to detail is not a task to hurry through. Nor is speed usually an element of a screen show. The time it takes to run a screen show is generally determined by the presenter's and the audience's needs, and it is a good bet that the presenter will be talking while the next slide is drawing. It is primarily while creating and editing slides and while printing that speed may be an issue.

NSTL first tests performance during common procedures, such as going to the next slide, switching to the slide sorter, and switching the template in a presentation. These tests indicate how each program handles screen redraws, a frequent occurrence when using graphics programs. Second, because audience handouts are so often part of a presentation, printing performance is also measured, both in color and in black and white.

Freelance Graphics is the fastest at most tests involving redraws, with PowerPoint a close second. In fact, the fastest times in all the screen-redraw tests were earned by one of these two programs. Charisma is fast when going to the next slide and is good at black-and-white printing, but it is the slowest of the programs at color printing. The complex Windows metafile graphic NSTL placed on one of the slides considerably slowed down Harvard Graphics' redraws involving that slide.

The Question of Quality

Quality is so important in a graphics program that NSTL weighted it twice as high as performance. We evaluated the programs for the quality of their templates and layouts, clip art, printed output, chart options, and screen shows.

PowerPoint delivered the highest quality of the tested programs, due to its excellent clip art, page layouts, printout options, and best use of the 256-color

PRESENTATION FEATURES

	CHARISMA 4.0	HARVARD GRAPHICS 3.0	LOTUS FREELANCE GRAPHICS 2.1	MICROSOFT POWERPOINT 4.0
Creating/editing presentations				
Number of unique templates/masters/backgrounds	75	88	101	165[1]
Templates globally and individually edited	●	●	●	●
Create slides via outliner	●	●	●	●
Outline expand/collapse	○	●	●	●
Number of outline levels	5	10	3	5
Number of clip-art symbols	>600	536	>500	>1100
Number of symbols in CD-ROM	>7000	○	○	○
Includes sound clip library	●	○	●	○
Electronic presentations				
Slide sorter	●	●	●	●
Number of transition effects and directions	58	51	33	44
Global and individual transitions	●	●	●	●
Preset slide display time	●	●	●	●
Manual slide display control	●	●	●	●
Presentation rehearsal	○	○	○	●
Draw on-screen during presentation	●	●	●	●
Add video/sound clips to show	●	●	●	●
User-created buttons for screen shows	●	●	●	○
Hidden slides	○	○	○	●
Continuous looping	●	●	●	●
Text tables and charts				
Automatic alignment	●	●	●	●
Automatic indent	●	○	●	●
Drag-and-drop text	●	●	●	●
Clip-art symbols as bullets	●	○	●	○
Superscript/subscript text	●	○	○	●
Arbitrary line/paragraph leading	●	○	●	●
Text frames/borders	○	●	●	●
Organization charts	○	●	●	●
Data charts				
3-D charts	●	●	●	●
Table chart	●	●	●	●
Pie, bar, line, area, and scatter charts	●	●	●	●
Mixed/overlay charts	●	●	●	●
Gantt charts	●	○	○	○
Chart templates	●	●	○	●
Incorporate free-form drawings/symbols	●	●	●	●
Graph noncontiguous ranges	○	○	●	●
Drawing features				
Number of drawing tools	6	9	9	5
Adjustable shape	●	●	●	●
Proportional drawing (squares and circles)	●	●	●	●
Rounded rectangles	●	●	●	●
Freehand shapes	●	●	●	●
Curved text	●	●	●	●
Bézier curves	●	●	●	●
Group/ungroup objects	●	●	●	●
Rotate objects to any angle	●	●	●	●
Slant selected objects	●	●	○	○
Mirror or flip shapes	●	●	●	●
Snap-to-grid points or objects	●	●	●	●
Colors and fills				
Gradient text fill	●	●	○	○
Bit-map text fill	●	●	○	○
Save edited color palette	●	●	●	●

[1] 55 templates, each in three versions: 35mm and on-screen, black-and-white overhead, or color overhead

● = yes; ○ = no

SUPPORT FEATURES

	CHARISMA 4.0	HARVARD GRAPHICS 3.0	LOTUS FREELANCE GRAPHICS 2.1	MICROSOFT POWERPOINT 4.0
Output				
Print presentation	●	●	●	●
Print outline	●	○	●	●
Print speaker notes/audience handouts	●	●	●	●
Print chart data with chart	○	●	○	○
Black-and-white print preview	○	●	●	○
Print slide numbers	○	●	●	●
File management				
OLE client and server	●	●	●	●
OLE 2.0	○	○	○	●
DDE	●	●	●	●
Deactivate links	●	●	●	●
Automatic file save by increment	●	●	●	○
Automatic file backup	○	○	●	○
File search by content/date/author	○	○	○	●
Stand-alone (run-time) screen show	●	●	●	●
Compress show for transport	●	●	○	○
Native data import formats				
ASCII	●	●	●	●
Rich Text Format	●	○	○	●
dBase .DBF	○	○	○	○
Microsoft Word for Windows (DOC)	○	○	○	●
WordPerfect for Windows	○	○	○	●
Lotus Ami Pro (SAM)	○	○	○	○
Lotus .WKS	●	●	○	●
Excel .XLS	①	①	○	●
Image import/export formats				
Windows Metafile (WMF)	●	●	●	●
Hewlett-Packard Graphics Language	●	③	②	②
CGM	●	●	●	②
Encapsulated PostScript	●	●	②	●
TIFF	●	●	●	②
Microsoft Excel .XLC	○	○	○	●
Lotus 1-2-3 (PIC)	○	○	②	②
PC Paintbrush (PCX)	●	●	●	②
PICT	●	●	●	②
Windows Bitmap (BMP)	●	●	●	②
Kodak PhotoCD (PCD)	②	②	②	②
CorelDraw (CDR)	②	②	○	②
Workgroup support				
E-mail enabled	○	●	●	●
Automatically route to workgroup	○	●	●	●
Share native files between PC and Mac	○	○	○	●
Simultaneous viewing of presentation over LAN	○	●	●	○
Lotus Notes support	○	○	●	●
Read-only access to locked files	○	●	●	○
Users maintain personal settings	○	●	●	●
Miscellaneous features				
Slide bureau service	○	●	●	●
Access to slide service from program	○	●	●	●
TWAIN-compliant	●	○	○	○
Number of Undo levels	100	4	10	1
Spelling checker	●	●	●	●
Global search and replace text	○	○	○	●

①Excel 4.0, not 5.0
②Import only
③Export only
● = yes; ○ = no

capabilities. With 1100 clip-art symbols and 21 page layouts, it offers the most diversity to users. The smooth blending of gradients when using the 256-color-capable Video Seven card gives slides the most professional look of the tested programs.

Freelance Graphics' best asset is its 101 unique templates, including the most interesting scenery and objects on the most eye-catching backgrounds. The on-screen look in 256 colors is less than desirable, even in VGA mode.

Charisma looks the best in VGA display of all the programs, but like Freelance Graphics, it loses quality when switched to a 256-color display. The templates are relatively simple, compared with those from Freelance Graphics and Harvard Graphics, but the more than 600-piece clip-art collection is diverse and of high quality. Charisma has the best-quality screen-show features, owing to its large number of effects, its sound clips, and layering for the most flexible slide builds.

Harvard Graphics offers only 31 templates, so it cannot match the diversity of the other programs. Although it has the smallest clip-art collection, the symbols are diverse and exhibit good quality. Harvard

About the Products

Charisma 4.0 .... $495
Micrografx, Inc.
1303 East Arapaho Rd.
Richardson, TX 75081
(800) 733-3729
(214) 234-1769
Circle 1003 on Inquiry Card.

Harvard Graphics for Windows 3.0 .... $395
Software Publishing Corp.
3165 Kifer Rd.
P.O. Box 54983
Santa Clara, CA 95056
(408) 986-8000
Circle 1004 on Inquiry Card.

Lotus Freelance Graphics for Windows 2.1 .... $495
standard version, single-user $395
Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(800) 343-5414
(617) 577-8500
Circle 1005 on Inquiry Card.

Microsoft PowerPoint for Windows 4.0 .... $339
(estimated retail price)
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
Circle 1006 on Inquiry Card.

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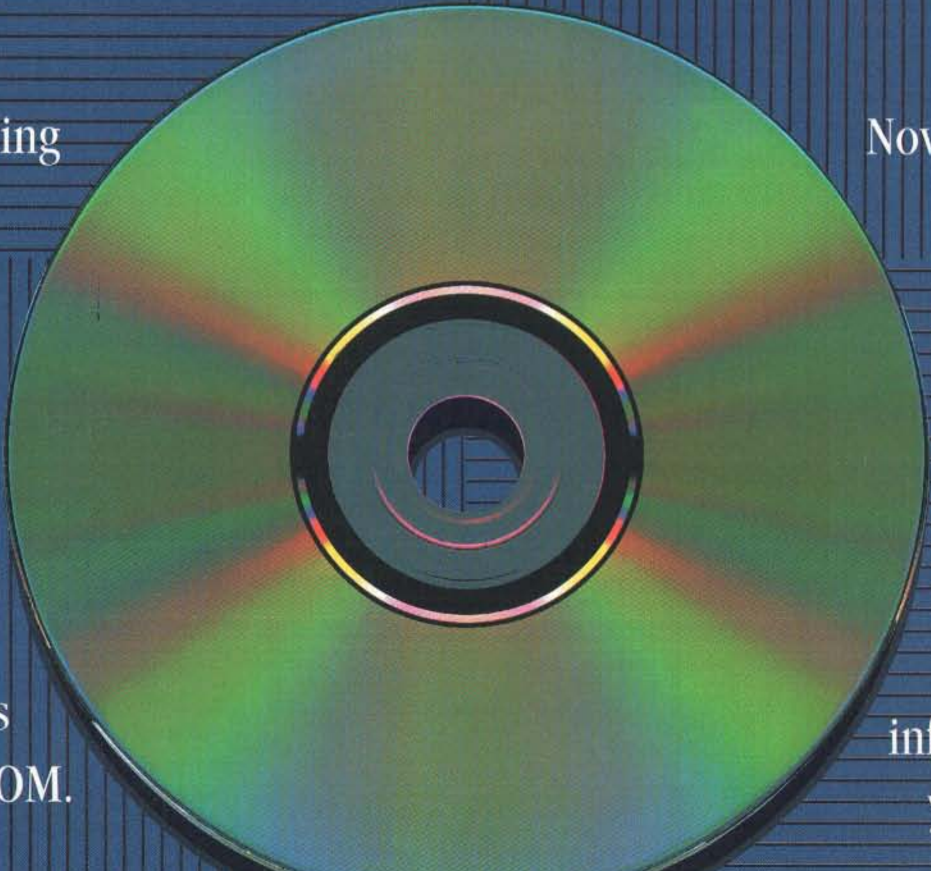

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Graphics' on-screen quality is good in both standard VGA and 256-color display.

The Perfect Pitch

The testers rated Charisma the most difficult of the programs to learn and use. This is because the program does so much and does not rely on other products in a suite or bundled applets to supplement its features. Instead, Micrografx offers a well-designed interface that gives you icon access to all the program's features. Charisma is not a particularly fast program, but it has the tools and effects to make visually exciting presentations, and its multimedia capabilities are extensive.

Harvard Graphics did not win in the testing primarily because it performed the slowest overall and had the lowest quality rating. It is, however, a well-rounded program with some innovative features. Its usability is good, due to the advisor system, and charting features are plenty. Harvard F/X contributes advanced text and object manipulation and eye-catching effects. And the conferencing feature will probably be emulated by other vendors.

Not long ago, Lotus Freelance Graphics was ahead of the pack, but now the program needs a major upgrade to keep pace with the competition. It is still an easy program to use, and its speed is impressive, so it continues to do well overall. Compared with the relatively new versions of the other programs, it is hard not to notice its lack of advice in choosing a template and its lack of help in creating the content of a presentation. Its drawing and charting options are also somewhat limited.

NSTL recommends Microsoft PowerPoint as the best all-around program. Although all the test programs are quite good, PowerPoint is the easiest to learn and use, has the best quality, is fast, and has extensive features. The program includes beautiful, high-quality templates and an extensive clip-art collection. PowerPoint's advanced presentation design aids are great for the inexperienced presentation author, yet do not get in the way of the more advanced presenter. ■

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Audience Share

Proxima's new Ovation+ projection panels do up multimedia

G. ARMOUR VAN HORN

Bill Cosby can sit down on an empty stage and hold our attention. Most of us don't have that gift. If he chose to show overhead transparencies, he could dump them all on the floor and get big laughs while rearranging them. I know from experience that I get another reaction entirely.

Whether or not you have good communications skills or comic timing, you can appreciate a little help in getting your point across. By projecting your PC or Mac display onto a screen, a full-color, active-matrix presentation product by Proxima or a competitor can give you all the power of the computer when you are presenting information to a group, without the clumsiness of spilled overheads or upside-down slides.

Proxima's newest family of panels, the Proxima Ovation+ series, is a good match for the multimedia capabilities available with today's desktop and portable systems. Two of the series, the 842C ($5695) and the 846C ($6695), have LCD control circuitry for displaying video and animation. All three Ovation+ panels, including the 840C ($4995), can display bright, nearly 24-bit color. The 840C and 842C have 8.4-inch active-matrix LCD panels; the 846C has a 9.4-inch panel that projects a larger image for bigger audiences.

The 842C and 846C can handle NTSC, PAL, and SECAM video. In all other respects, the three Ovation+ panels have the same features and options, including stereo sound inputs and outputs. The price includes an infrared remote control, but you must send in your warranty card to get it. Options include the Proxima Cyclops Model 2050 interactive pointer system ($495) with a plug-in sensor unit and an infrared wand, and a laser pointer pen ($295) that also works with the Cyclops sensor eye. Both the Cyclops wand and the laser pen act as long-distance mice, giving you cursor control of graphical-presentation applications, with the wand at the screen and the pen from anywhere in the room.

I reviewed an Ovation+ 842C projection panel, equipped with the optional Cyclops 2050 system and the laser pointer. The Cyclops software was in beta testing. I attached the system to two 486 systems running different display systems, and three Macintosh setups that included an AV model and a Power Macintosh. Used with Proxima's Ovation+ 920WS ($14,795), which has 1280- by 1024-pixel resolution, the Cyclops can also work with Sun workstations running Solaris.

The Proxima Ovation+ 842C projection panel comes with an infrared remote control (inset) that offers functions for controlling the panel and your presentation. Also shown is the optional laser pen that works with the Cyclops interactive pointer system.

Finish Details

The Ovation+ 842C is a well-finished, 6.5-pound, 15- by 12.9- by 2.1-inch unit that sits on a standard overhead projector. Its total weight is a little higher with power supply, accessories, and cables. First-time setup took me less than a half hour, and subsequent setups took less than 10 minutes.

Along one side of the panel are the dual sets of connections for stereo sound in and out, video inputs for S-VHS and an RCA jack for other video sources, a serial port for directly connecting a Microsoft mouse, a "mouse out" pass-through port so that Cyclops users can control software through the serial port on the host computer, pass-through Macintosh and VGA outputs for driving the display of a desktop host computer, the connection accepting the host computer's video output, and the power socket. The cables to connect the panel to standard Macintosh video (DB-15 with sense pins) and VGA are included with the panel, with a hefty power brick and power cables of generous length.

Cyclops buyers receive a cable to connect the Cyclops output to standard Intel/PC serial ports and a Y-cable to connect to the ADB (Apple Desktop Bus) of a Macintosh. Standard equipment is an infrared remote control to activate the panel's built-in on-screen menuing capability.

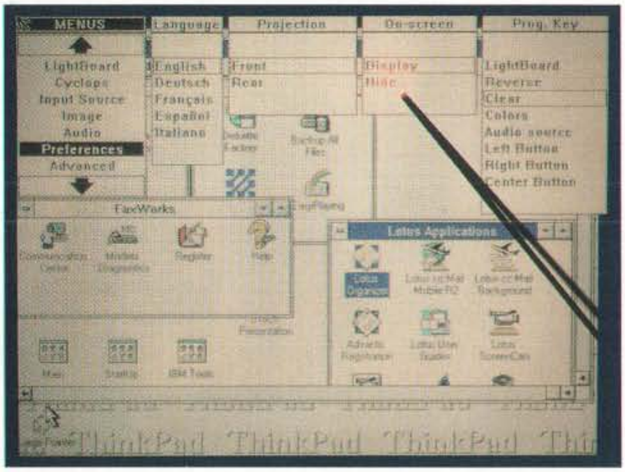
To exercise the Ovation+ to its full potential, I installed the Cyclops option in the projection panel, a simple matter of slipping off a plastic cover and sliding the Cyclops sensor unit into place in the projection panel. The Cyclops eye is an electronic camera that watches the projection area for the presence of the red pointer from the Cyclops wand or the optional laser pointer.

Up and Presenting

Setup for a presentation includes several steps and a number of cables, but the functions of each will be completely obvious after you have used the system a couple of times. After plugging in the Ovation+ power cable, the first step is to plug the provided video cable from the LCD panel into your computer's monitor connector. Optionally, you can plug a monitor into the panel.

To provide you with remote control of the presentation software running on your computer, you use a mouse connection from the panel to the PC serial port (Microsoft-compatible) or via the Mac's ADB port. You can use a serial mouse plugged into the panel or the optional Cyclops system. If you plan to alternate a video source with computer output, you connect a playback deck or other video source to the appropriate video inputs of the projection panel.

The Ovation+ 842C displays 640- by 480-pixel resolution, and the pass-through connection described above works with either Macintosh or PC systems set to that resolution. The Ovation+ panels can also



With the Ovation+ infrared remote control, you can overlay the panel's built-in configuration menu over the projected image. With the Cyclops pointer (shown) or the remote laser pointer, you can configure how Ovation+ works, including color adjustments, or control the displayed applications with a mouse.

display 800- by 600-pixel images by selectively dropping pixels (this works best with graphics images rather than screens full of text). The Macintosh video cable supplied includes the sense pins necessary to set Quadra internal video controllers to that resolution. I was also able to install the Ovation+ as a second monitor with the internal video on a Quadra 700; a NuBus video card supported the primary display.

The Ovation+ panels have a palette of 16.7 million colors, and Proxima claims that it can display the equivalent of 16.7 million colors simultaneously by using the techniques of gray-scaling, dithering, and frame-rate modulation to fool the eye. If the result isn't true 24-bit color, I found it passably close.

Stereo audio is supported directly, but the system will take mono inputs and simulate stereo output. You can plug the output from your sound card into the left input and the audio from your video deck into the right input and have the appropriate signal sent to both output channels.

Eye of the Cyclops

You must calibrate the Cyclops system for ambient light and projection distance. With the system on under the expected lighting conditions, the remote control is used to invoke the Cyclops calibration. Using either the wand or the laser pointer, you point and click on each corner of the screen in turn, and the Cyclops is then able to determine the relative location of future light clicks as long as the illumination level in the room does not change and you do not move the projector.

About the Product

Proxima Ovation+ 842C................$5695
(includes infrared remote-control and Mac or PC remote-control software; Cyclops Model A2050 ($495) and A90 laser pen ($295) pointing devices optional)

Proxima Corp.
9440 Carroll Park Dr.
San Diego, CA 92121
(800) 447-7694
(619) 457-5500
fax: (619) 457-9647
Circle 1009 on Inquiry Card.

You use the wand from immediately in front of the screen, with the LED tip touching the projection screen. You can use the laser pointer from the back of a room of reasonable size, but it takes a steady hand to manipulate program menus accurately. The larger square buttons used in many tutorials should offer no problem. Although the ability to roam around the room with the remote control and the laser is appealing, I had difficulty controlling small movements with the laser.

Whether you use the LED wand or the laser pointer, manipulating items on-screen takes a little getting used to. The prerelease Cyclops software may explain some of the roughness. Operations became smoother with practice.

An included program called Lightboard creates an overlay on the projected image, onto which you can draw with the wand, laser pointer, or attached mouse. You can use the remote control to turn on the Lightboard option. You then select from a palette of eight colors and easily highlight portions of the display, much like John Madden highlighting the progress of football plays on television. You can switch the Ovation+ panel to straight white or black and use it for illustration, but the pointers do not support smooth drawing well enough for this to be very useful.

The Ovation+ converts analog video sources (NTSC, PAL, or SECAM) to digital for display on its active-matrix LCD screen. The new Proxima panels do true scaling of PAL down to 640- by 480-pixel resolution. For testing video, I used a Sony Hi-8 S-Video camera and displayed the same source simultaneously in three ways. I dubbed the output to VHS tape for playback on a traditional TV set, captured the S-Video material with a Quadra 840AV and displayed the resulting QuickTime video in Adobe Premiere, and played the material directly from the Sony camera to the Ovation+. Although neither digitized version matches the results of modern television screens in color range and shadow detail, the Ovation+ proved to be a close match to the Quadra's video, even when projected to many times the size. The remote control has a single button to cycle between the two video sources and the computer, making it easy to include taped video segments within a presentation.

Projector Optics

I should point out that, regardless of which projection panel you elect to buy, the quality of the optics in the projector will be more harshly exposed in this application than with any other use of a projector. Where the projector was well focused, the display looked tack sharp, but the projectors I used for testing always left some areas of the presentation out of focus. This is much more disturbing when you are displaying a typical computer interface than when you are displaying photographic matter.

The manufacturer also suggests using a bright (3000 lumens or greater) projector. A complete LCD projector with built-in lamp and optics, rather than the LCD panel, might be a better choice if the quality of the overhead projectors available is not known. Proxima offers projectors with optional Cyclops interactive pointers as well, although there is both a weight and cost penalty to this approach.

Conceptually, the possibilities of this system are great for presentations, computer training, and traditional classroom use. The ability to modify a presentation moments before the lights dim might mean never apologizing for a misspelled word.

The combination of full color and the interactive pointers takes computer presentations to a new and important level. Although rather expensive for a single user, the price should not be an obstacle for corporate, training, and educational uses. Proxima's implementation of this system is complete, includes all the necessary cables and batteries, and shows a thorough understanding of the application. ■

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dBase Does Windows

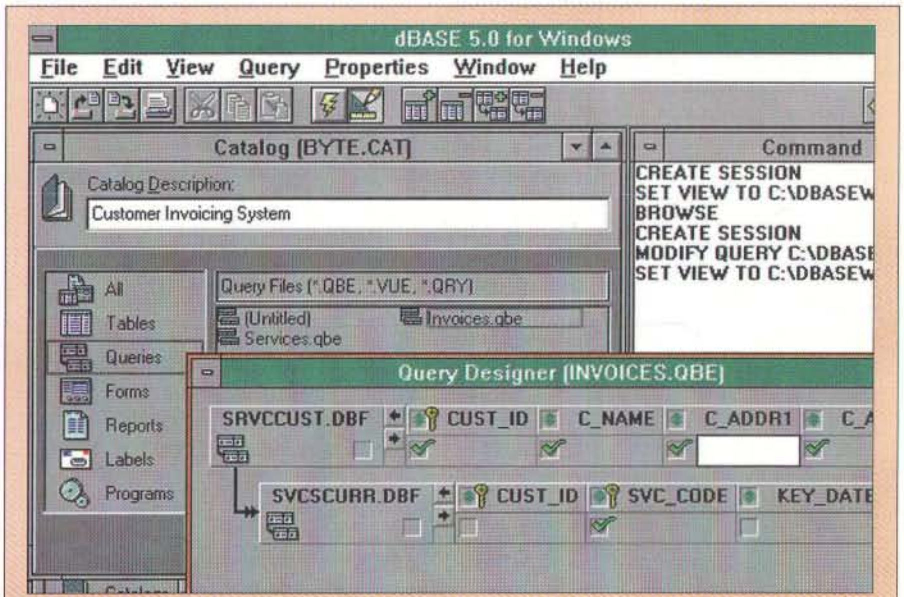
Borland's Windows version of an industry-standard database adds object-oriented functionality and retains backward compatibility. But is it enough?

JIM CARLS

Long ago (that is, in the mid-1980s), dBase was a key weapon in the rebellion against mainframe DBMSes (database management systems). As it earned the interest and then the devotion of oppressed middle managers looking to capitalize on the PC, dBase built a huge following and grew more powerful through several versions.

Then, alas, came dBase IV, the Jabba the Hut of database managers, a memory-gobbling slug of a program with an inclination to choke on program code too modular for its taste. A hemorrhage of users followed. Then parent company Ashton-Tate was acquired by rival Borland International. Observers wondered if Borland would simply kill dBase, but even after the exodus, the dBase users and programmers remaining were legion. Borland released dBase IV 2.0, which finally ended the memory problems, but the program was still based on the waning DOS interface.

Now that there is a Windows version of dBase, the question is whether the current incarnation of dBase can compete against the likes of Microsoft Access, FoxPro for Windows, and even Borland's own Paradox.



Catalog Description: Customer Invoicing System

```
CREATE SESSION
SET VIEW TO C:\DBASEW
BROWSE
CREATE SESSION
MODIFY QUERY C:\DBASE
SET VIEW TO C:\DBASEW
```

dBase for Window's object-oriented Query Designer lets you add tables and records to a query by dragging and dropping them. Here, the Query Designer is editing a query of two tables, with the equivalent code displayed in the command windows.

Vital Signs

The revamped dBase is a likely contender. For one thing, programs written in dBase III+ and IV will generally run as-is in the command window (which replaces the dot prompt of earlier versions). There are a few compatibility items you need to check, but these are clearly explained in the manuals, a READ.ME file, on-line help, and a module called the Component Builder. Problems are most likely to result from unlucky coding choices you made while developing under a previous version. Specifically, you might have used function names and variable names that have since been added to the list of dBase keywords. If so, you'll have to change them to avoid conflicts.

To take you beyond mere backwards compatibility, the Component Builder can convert some components (specifically .FMT, .FRM, and .LBL files and the menu definitions within .PRG files) into dBase for Windows code that takes advantage of the object-oriented Windows user interface.

The new version is more than simply a Windows-interfaced version of dBase IV. The dBase language has acquired the features available in general-purpose languages (e.g., C++ and other Xbase languages, such as Clipper) that help you build flexible, rock-solid applications. These include a preprocessor, local and static variables, code blocks, and the ability to use procedures or user-defined functions interchangeably wherever the language can accept an expression.

dBase for Windows is an object-oriented development system, giving you the ability to declare your own object classes. True, you can still write procedural dBase code until you retire, but you can also take advantage of the language extensions to make the transition to OOP (object-oriented programming).

Although the manuals contain clear introductions to the subject, it is the Two-Way Tools feature that can really help smooth the OOP transition. With Two-Way Tools, the definitions of objects you create visually are stored as dBase code in separate files. You can create an object and then open, view, and even edit the resulting code file. Not only do you create your own examples, but you can easily do search-and-replace code changes that would be difficult using only a mouse-driven interface.

Creating a Sample Application

Installing dBase is straightforward, unless you don't have 21 MB of space on your hard disk for a full installation. My original disk set included a bad disk, but Borland's technical support soon sent a replacement. The installation program checks for adequate space and lets you do a minimal install if you're too cramped for room.

To get a feel for the new version, I created a basic billing system similar to what a franchised service organization, such as a pest-control or building-maintenance company, might use. The system required six tables organized around a central table to which services would be posted, billed, and paid. In order to provide the data necessary to create the service records, I set up reference tables for customers, franchisees, service types, billing-table headers, and billing-table contents.

The first step in creating such a system in dBase is to set up a "catalog," a concept retained from earlier versions and equivalent to a "project" in FoxPro and the more traditional "database" in Access.

Although the command window gives you immediate access to all old (and new) commands, the easiest way to create anything is through the Navigator, which is a control panel similar to those in other Windows DBMSes. All files of a certain type in the system are grouped under an icon. Each list of files includes an untitled file, with which you can create new ones of that file type. Although a catalog is a file type, opening a catalog is like opening a subnavigator, which limits the file list to those in the catalog. For a quick introduction to setting up a system (or if you are brand new to databases), a set of interactive tutorials easily walks you through the process as you create your own files.

After establishing a catalog for my sample system, I initialized a new table by clicking on the tables icon, then double-clicking on the untitled table. Anyone familiar with dBase will be familiar with setting up the table fields, because the arrangement of name, type, width, decimals, and index fields is the same as it is in dBase IV. What is new is the ability to push a button and create a Paradox table just as easily.

Unlike some DBMSes, dBase does not store such things as valid clauses, formatting, or field labels in the table definition. Longtime dBase users will be accustomed to this approach, but if you're setting up a system that will be used by people unfamiliar with dBase, avoid giving them access to direct table editing; stick instead to the easier methods of using forms or a carefully crafted browse or query.

About the Product

dBase for Windows..........$400
Borland International Inc.
100 Borland Way
Scotts Valley, CA 95066-3249
(800) 331-0877
(408) 431-1000
fax: (800) 408-0001
Circle 1010 on Inquiry Card.

Making Queries

Unless you are working from an extremely simple database design, you will create queries as the basis of your forms and reports. You use the Query Designer for this (see the screen on the previous page). It lets you add tables graphically to the query, order the records, pick fields, and set relationships among the tables. I clicked on the untitled query in the query list to create a general-purpose nonfiltered query for use with the services table. The system automatically prompts you for a file to use as the basis of the query, in this case the services table.

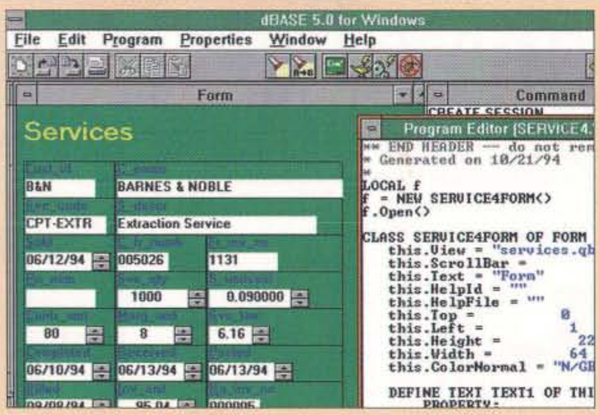
To add other files, you choose an icon from the speedbar. Once you've decided how files in the query should be related, you make the connection by dragging from the parent file to the child file. When you do, a dialog box appears in which you set the specifics of the relation, including referential integrity, which prevents the child records from becoming orphans if someone tries to delete the parent.

Form Designer

Since version IV, dBase has had reasonably good form-design tools. In the Windows version, these have been enhanced to make good use of the graphical interface and the program's object orientation. The Form Designer eliminates much of the manual coding that the older DOS versions of dBase required.

You can choose to create a form manually, or you can use the Form Expert (see screen), which can automatically fill in items in the Form Designer. You can create four types of forms with the Expert: columnar, form, browse, and one-to-many. The columnar and browse formats will be familiar to experienced dBase users. The form layout makes a best guess at laying out a form with the least wasted space, resulting in a rectangular group of fields and labels. The one-to-many format is a columnar layout in which the Expert embeds subforms to display multiple records from a linked table. Such a form might review unbilled services for each customer prior to invoicing, for example.

I created two sample forms for the invoicing system: one to review and edit service records, and another to preview customer billings. I used the form layout for the service-record form and created a reasonably clean-looking layout that could be used for data entry or editing.



CREATE SESSION

B&N
BARNES & NOBLE
CPT-EXTR
Extraction Service
06/12/94
005026
1131
1000
0.090000
80
8
6.16
06/10/94
06/13/94
06/13/94

```
** END HEADER -- do not rem
* Generated on 10/21/94
*
LOCAL f
f = NEW SERVICE4FORM()
f.Open()

CLASS SERVICE4FORM OF FORM
   this.View = "services.qb
   this.ScrollBar =
   this.Text = "Form"
   this.HelpId = ""
   this.HelpFile = ""
   this.Top =          0
   this.Left =          1
   this.Height =         22
   this.Width =         64
   this.ColorNormal = "N/GB

   DEFINE TEXT TEXT1 OF THI
```

The Form Expert provides help in designing four types of forms. Here, the Form Expert makes a best guess at laying out a form in the least amount of space. In the window at right is the program code generated when the form was created.

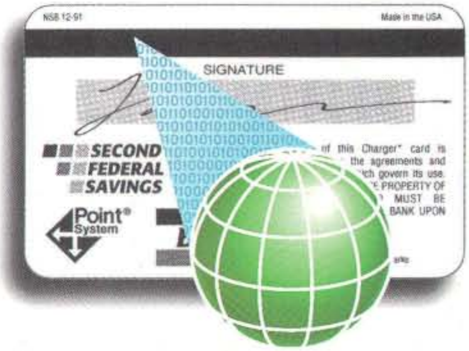
I found two problems in the resulting form, which was required to verify three secondary key entries (the customer ID, the service code, and the franchisee ID) during creation of a service record. But when I added these three fields to the form, they appeared as simple input fields like the others, even though I'd set up a relation to the corresponding file via those fields. Although you can delete the field from the form and replace it with a Combo Box, the Combo Box doesn't let you enter a new code. Any Windows database should offer a form object with specific properties that provide access to a related file via both a pick list or a call to another form.

I was also disappointed to find that the form, which included about 35 fields drawn from an unfiltered query of four files, seemed slow to appear, even though my test machine was a 486SX with 12 MB of RAM. Scrolling through records was reasonably quick (although slow compared to, say, a DOS Clipper screen), but a move to the top of the file could take up to 10 seconds. The speed increased to roughly a half second after I rephrased the query. A change in the order of the records and indexes may have caused the improvement.

I did, however, like the automatic sizing of the form's design grid to match the font in effect. This seemed to be easier to work with than one of arbitrary size like that found in Microsoft Access.

The other form I created was for previewing billings. It employed the one-to-many format to display data from a query designed to show only eligible services for each customer. The Form Expert generated this without any problem, producing a layout with space for information about

THE REAL TEST OF A REALTIME OS . . .



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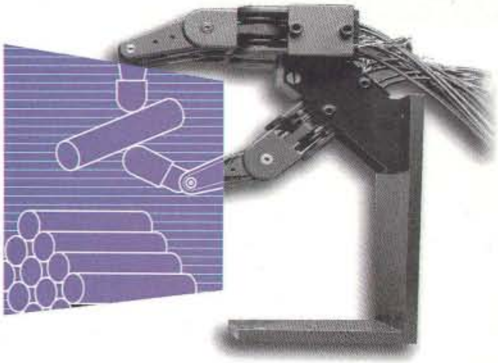

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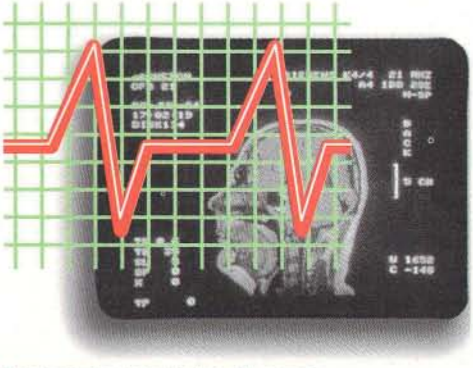

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each customer at the top and a browse display of services below that. If designed properly, this base form would make it easy to manage service billings from a single screen.

What's on the Menu

If you are developing a full DBMS, the Menu Designer, which is a subfunction of the Form Designer, offers a simple tool for creating the menus you'll need. Once you call it, Menu Designer presents a blank space in the top left corner of an empty menu. You simply fill out the options you want, moving across to create a menu bar item or down to create items on a drop-down menu. In the latter, tabbing to the right creates a cascading menu item. Once you've established the layout, you can edit the properties of each item to make the menu operational. You can set the menus to replace the normal dBase menu or to reside inside a form window.

Reports from the Field

Reporting functions in dBase for Windows are provided by a capable third-party package, Crystal Reports for dBase, which is almost seamlessly integrated with the main program. Like many band-oriented Windows report writers, it provides full control over formatting, such as multiple fonts, graphics elements, and report sections, with drag-and-drop ease. You can place any dBase field type in a report, including memo fields, graphics, and OLE objects (you should probably limit OLE objects, though, to those your printer can understand).

There's also good news for professional developers, who will be able to distribute applications freely with the $495 Distribution Kit. Also, a $10 ODBC socket kit facilitates access to ODBC data sources.

It appears that faithful dBase users have been rewarded for their patience. dBase for Windows preserves their years of investment but propels them firmly towards the future of database software. Its compatibility, Windows interface, and object orientation establish it as a big-league player right beside other popular DBMSes such as Paradox and Access. If Borland can resolve some of the speed problems (which may happen when a compiler appears), dBase could regain its status as a real killer app. ■

Jim Carls is a consultant, developer, and freelance writer living in Memphis, TN. He can be reached on the Internet at 75035.3622@compuserve.com or on BIX c/o "editors."

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Data Acquisition	28
Database	29
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Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
Operating Systems	39
OS/2	54
Programming Languages/ Tools	40
Security	41
Shareware	42
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18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68
69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
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103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119
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137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153
154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170
171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187

Inquiry Numbers 188–374

188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204
205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221
222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238
239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255
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Inquiry Numbers 375–561

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Inquiry Numbers 562–748

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732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748

Inquiry Numbers 749–935

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Inquiry Numbers 936–1122

936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952
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1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119 1120 1121 1122

Inquiry Numbers 1123–1309

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Inquiry Numbers 1310–1489

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Internet with Style

Netscape Communications rebuilds the World Wide Web

BEN SMITH

The threads that form the Internet hang like cobwebs, reaching out to connect this tenuous community of people and resources. Tools for finding and retrieving information and for contacting and communicating with the systems and users differ greatly, reflecting their varied origin. Each has its own purpose, interface, operations, and syntax. Most of the tools are command-driven.

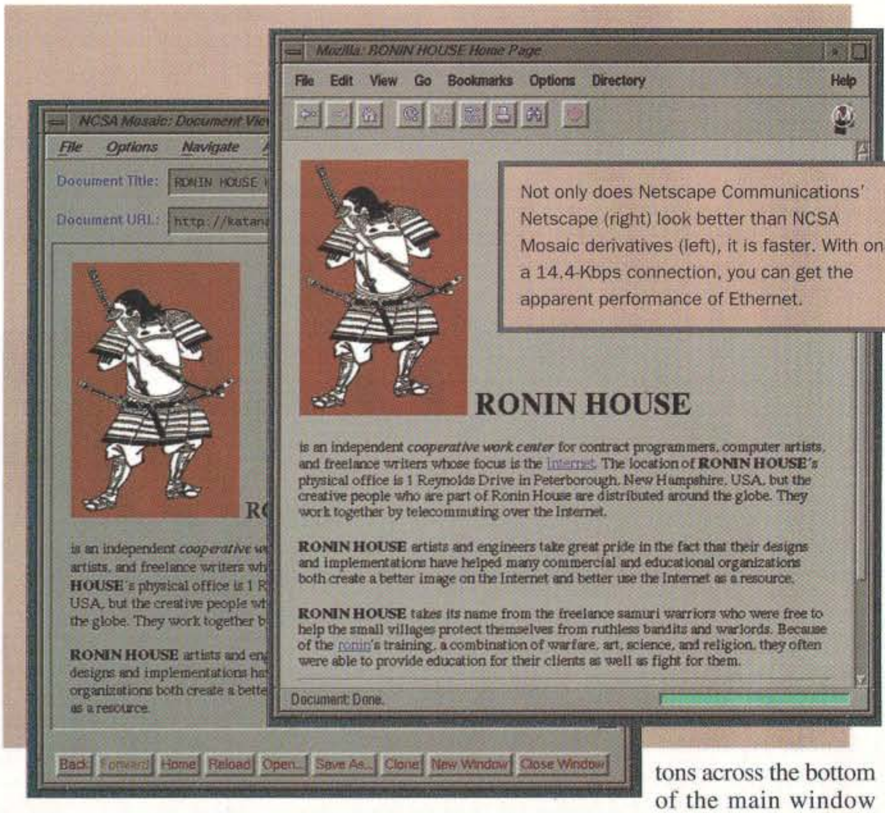
Mosaic was designed and built by Marc Andreessen and a team at the University of Illinois at Champaign/Urbana–hosted NCSA (National Center for Supercomputing Applications). It is the first Internet interface that combines the hypertext browsing of WWW (World Wide Web), the file retrieval of `ftp`, and numerous image viewers under one GUI. (For more information, see "Mosaic: Beyond Net Surfing" on page 75.)

The NCSA Mosaic browser not only runs on Unix workstations but also—and more important—on Windows PCs and Macs. Conceptually, it has what is needed to make a commercial Internet resource palatable enough to be marketable. When it was first shown to the public, Mosaic was an instant success. Now Andreessen and most of the team have rebuilt NCSA Mosaic so that it is industrial strength and commercial grade. It is called Netscape.

Fast, Friendly, and Free

Mosaic primarily works with HTTP, the core of WWW. HTTP is the result of an effort initiated primarily through CERN, the European Particle Physics Laboratory in Geneva, Switzerland. The servers don't need to be supercomputers; any Unix system will suffice, and there are now servers for operating systems such as Windows NT and even DOS. Mosaic clients, often called browsers or viewers, can be as simple as a PC running Windows.

Traditionally, the performance bottleneck has been the connection between servers and clients. NCSA Mosaic was intended to be a prototype, a proof of concept. It was developed for networks providing 10-Mbps or better, not your typical connection to the Internet. The reasons for this high bandwidth requirement are Mosaic's computing and communications model and its appealing incorporation of digital multimedia elements.



RONIN HOUSE

is an independent *cooperative work center* for contract programmers, computer artists, and freelance writers whose focus is the Internet. The location of **RONIN HOUSE**'s physical office is 1 Reynolds Drive in Peterborough, New Hampshire, USA, but the creative people who are part of Ronin House are distributed around the globe. They work together by telecommuting over the Internet.

RONIN HOUSE artists and engineers take great pride in the fact that their designs and implementations have helped many commercial and educational organizations both create a better image on the Internet and better use the Internet as a resource.

RONIN HOUSE takes its name from the freelance samuri warriors who were free to help the small villages protect themselves from ruthless bandits and warlords. Because of the ronin's training, a combination of warfare, art, science, and religion, they often were able to provide education for their clients as well as fight for them.

Not only does Netscape Communications' Netscape (right) look better than NCSA Mosaic derivatives (left), it is faster. With only a 14.4-Kbps connection, you can get the apparent performance of Ethernet.

Like most Internet utilities, the development of NCSA Mosaic virtually stopped at the conceptual level. As a result, most of the attempts by commercial software publishers to clean it up and make an efficient, robust commercial product of it have not eliminated its basic design flaws.

Netscape Communications, a company formed from most of the original Mosaic team and under the business tutelage of Jim Clark, founder of Silicon Graphics, has changed Mosaic from the bottom up. While maintaining conformance with WWW structures and existing servers, it has completely rewritten the Mosaic browser/viewer as well as the HTTP server. The products are Netscape (the browser/viewer) and Netsite (the server).

A Better Browser

Netscape is both visually more appealing and operationally more functional than the original NCSA Mosaic. The labeled buttons across the bottom of the main window have been replaced with iconic buttons at the top. Menus are easier for the novice to learn because they follow common models (e.g., the leftmost drop-down menus are File and Edit).

The File menu is much simpler—only nine items. The important selections that were part of NCSA Mosaic's 16 File operations have been distributed over new drop-down menus. For example, the Reload and Refresh menu items now reside in a drop-down menu called View, along with a handy function for people developing documents for WWW—Source, a separate window for viewing the HTML (Hypertext Markup Language) source code of the current page.

The Preferences screen incorporates some of the fine style of the NextStep user interface. Through it, you can configure your browser in nearly 50 ways, but without having to hand-edit a complex configuration file.

Many of the technical-information displays can be turned off to give a less-cluttered look. Netscape Communications' viewer/browser has been carefully designed for the nontechnical user rather than for computer scientists, engineers, and physicists. However, the improved user interface is not nearly as important as the performance improvements.

Without requiring anything different from the `httpd` server, Netscape has not only made the document-retrieval process faster by a factor of 10, it also makes the apparent speed (for the user) instantaneous. The goal was to bring the optimum bandwidth requirements down from 10-Mbps Ethernet speed to a level that is more realistic for the majority of Internet connections: 14.4 Kbps—that of a PPP or SLIP connection over voice phone lines.

By displaying part of the document before its transfer is complete, there is an improvement in perceived performance. But there are some real performance improvements as well, achieved through a trimmer screen layout, better network communications libraries, automatic caching of previous pages, and streaming and compression techniques built into the client.

Perhaps the most amazing thing about Netscape is the price. It's free for noncommercial users, just like the original NCSA Mosaic.

Industrial Strength

If the browser/viewer is free, how does the company expect to make any money? The answer lies in its servers, replacements for the complex-to-install-and-configure, ubiquitous `httpd`. Netscape Communications has two versions: Netsite Communications Server and Netsite Commerce Server. The first of these is simply a more robust and efficient `httpd`, one for which you can get technical support.

About the Products

Mosaic Netscape.....free for noncommercial users

Mosaic Netsite Communications Server......................$1495 introductory, $5000 list

Mosaic Netsite Commerce Server................................$25,000

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Unlike many other WWW servers, it doesn't require that your server already be attached to the Internet to access documentation. In fact, you can easily set up a private web for distributing information in your organization.

The efficiency that Netsite includes is one that any commercial-grade WWW information provider is going to need: a better computing model that scales well to heavy request loads and client connections. The generic `httpd` required a new process for every WWW data request. The creation and destruction of processes and communications sockets are heavy burdens on the operating system. This load may not be noticeable when there are only a few every second, but if the requests are dozens or even hundreds a second, any system is going to be brought to its knees.

Netsite servers use a different model, where a configurable number of server processes are always running. Because they all use shared libraries (the operating system must support this), the server processes use less total memory than in other popular servers. The server also has built-in routines for handling image

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components of HTTP communications.

While it is common practice to extend WWW servers with external scripts and executable programs using WWW's CGI (Common Gateway Interface), frequent requests to these external programs can result in the same kind of system overload as spawning a new process for each new request. Netsite servers are designed to have these extensions run under the same process as the server through the use of dynamic program module loading.

The design criteria for Netscape Communications' WWW servers are focused on providing the greatest number of services with the least impact on the server's system resources. Many of the system requirements have only recently become available on modern Unix systems and won't be realizable on older systems that have no support for dynamic loading and shared libraries.

Commercial Grade

The second version of the server, Netsite Commerce Server, has a special strength—secure communications and server authentication. This lets commercial Internet service providers and their customers carry on secure transactions over the Internet.

The Netsite Commerce Server is Netscape Communications' most important product because it offers the basic requirements for secure transactions over the otherwise open-for-snooping-and-spoofing Internet. The authenticated and secure communications link is achieved as a wrapper (using RSA encryption and digital signatures) to the client/server communications. The underlying server and client protocols remain the same.

The design is similar to PGP (see "Pretty Good Privacy" in the July 1994 BYTE) in that a signature is verified through a public key retrieved from a trusted source. Once verified, the key transmitted from the server to the requesting client is used to encrypt and decrypt subsequent communications in the session. The Commerce Server requires Netscape as its client.

One important difference, particularly for video and sound, between the algorithms used in PGP and the Netsite Commerce Server is that Netscape Communications' encryption is streaming, and PGP requires block transmissions. Any commercial transactions that take place through this link must rely on the same vendor/customer trust used in credit-card purchases over the phone. At least the communications link is secure, unlike voice links made with portable and cellular phones.

Netscape Communications is in the process of writing the API for linked extensions to both its servers, as well as HTML document authoring tools that will help in creating page layouts as well as allowing dynamic image and text editing.

Netscape Communications may not be able to clean out the loose threads and cobwebs of the Internet, but its client and servers are the kinds of products the Internet needs to make the transition from being a cobweb of experimental projects to a serious commercial marketplace. ■

Ben Smith is a consultant, former BYTE Lab testing editor, and author of UNIX Step-by-Step *(Hayden Books, 1990). You can reach him on the Internet at ben@ronin.com or on BIX as "bensmith."*

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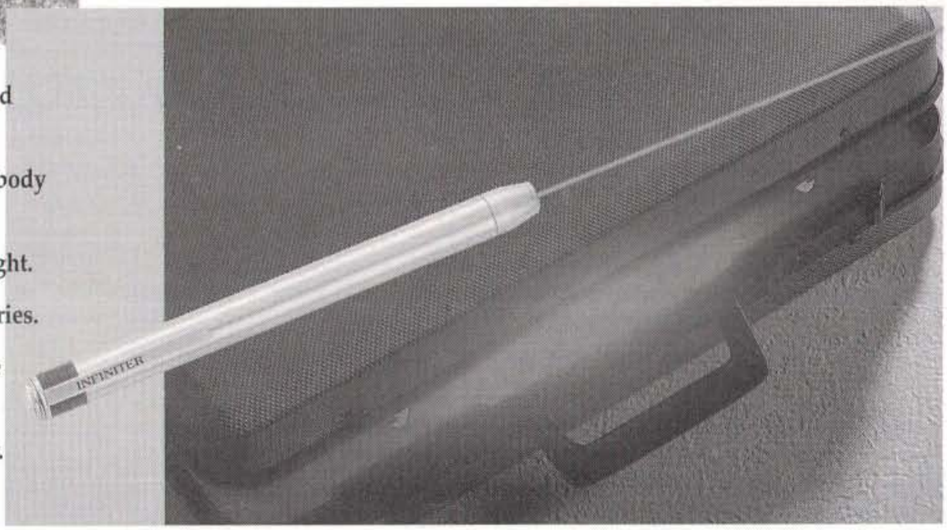

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Bringing 3-D Modeling to PCs

Seeking a price breakthrough in features-based 3-D modeling, Autodesk makes a promising start with AutoCAD Designer 1.0

EVAN YARES

Autodesk, the developer of AutoCAD, has been at the top of the PC CAD market for about 12 years. By any standard, the company has had quite a run, managing to make so much money that it must have had a hard time spending it all. Still, not all is well with Autodesk. Lurking behind its success has been a big question: Where does the world's sixth-largest software company go from here?

At one time, Autodesk won business due to the mistakes of its competitors, but that's happening less often. AutoCAD, which still accounts for the vast majority of Autodesk's sales, is not the technical leader it once was. A program that in 1982 offered 80 percent of the features of high-end CAD systems for 20 percent of the price could in 1994 perhaps lay claim to providing a quarter of the technology at a quarter of the price.

The solution seems to be in developing advanced add-in products, such as AutoCAD Designer 1.0. Designer is a $1500 parametric feature-based modeler that works with AutoCAD Release 12. It is based on the ACIS (American Committee for Interoperable Systems) solid-modeling kernel from Spatial Technology (Boulder, CO) and DCM-2D constraint management technology from D-Cubed Ltd. (Cambridge, U.K.). Designer gives AutoCAD some of the solid-modeling capabilities found in such workstation-based CAD programs as Pro/Engineer from Parametric Technology Corp.

Getting the Parameters

Designer plows no new technological ground, but it represents a price/performance breakthrough. Although Pro/Engineer, the competitive product most often mentioned in the same breath as Designer, sells for about $18,000 in standard trim, the combined price of Designer and AutoCAD is $5250.

To understand what Designer brings to AutoCAD, you first have to understand the vernacular used to describe it. The term *parametric* has a specific meaning in the context of CAD. It implies that the models created in the CAD system are not dimensionally fixed, but rather are defined by a set of dimensions and geometric constraints. If any of the defining dimensions are changed, the rest of the model is affected.

Consider a rectangle. Its dimensions are length and width. Its geometric constraints are that its top and bottom sides are horizontal, its left and right sides are vertical, and all its sides are connected end to end. In most CAD systems, you can draw a rectangle as a series of lines, but the software will not keep track of the relationships between the lines. Move a line, and you no longer have a rectangle. A parametric program, by comparison, keeps track of and preserves such relationships between objects.

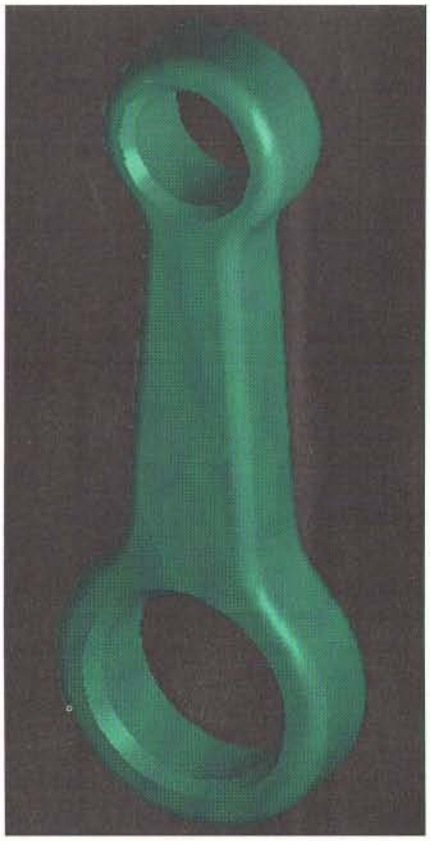
An Awareness of Limitations

The term *feature* describes a 3-D object created by extruding, sweeping, or revolving a closed profile. In Designer, all objects are created by starting with a base feature and then joining, intersecting, or subtracting other features from it. I've outlined the process in the text box "A 3-D Feature Presentation: Anatomy of a Model," which describes how I built a 3-D test model of an automotive connecting rod. The resulting fully rendered image is shown to the right.

In practice, however, Designer can be annoying to use. In the real world, you'd never find a connecting rod as simple as the example I used. Most connecting rods use split caps and have subtle machining details that are hard to represent in Designer. It's not surprising, then, that when I tried to draw a real-world connecting rod, I ran headlong into a few of Designer's limitations.

First, when I was constraining a profile, Designer turned some fillets (i.e., arcs that are tangential to two lines) into loops. The way to work around this was to constrain the profile in a different order. An alternative would have been to draw the initial sketch more accurately.

I ran into more constraint problems when I accidentally over-constrained several profiles. Frankly, it takes a good geometric eye to tell how a profile should be constrained; it shouldn't be so difficult. An Autodesk spokesperson claimed that over-constraining is a problem with CAD programs in general, and that the next version of Designer will make it easier to remove constraints individually at any point in the constraining process.



A fully rendered test design created in AutoCAD Designer 1.0. The steps in the design process are illustrated on the next page.

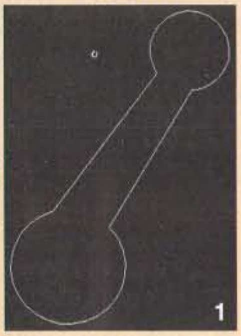
Furthermore, after creating the major features in one of my rod designs, I found that Designer could not apply the fillets I wanted because it has certain design limitations that you don't find in high-end CAD programs. I wanted to apply a variable radius fillet, but Designer makes no provision for it. Other problems I had with filleting are less explainable: Designer simply gave up on some fillets that it should have been able to do.

Still another problem cropped up when I tried to change the creation order of some of the features. No facility exists for doing

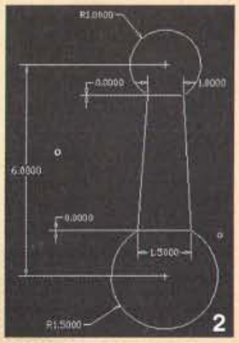
A 3-D FEATURE PRESENTATION: ANATOMY OF A MODEL

Although creating a part in AutoCAD Designer is, for the most part, pretty simple, it is not completely painless. For this review, I created an automotive connecting rod, a process that is depicted in the photo sequence that follows.

First, you create a simple sketch of the part's outline. The sketch doesn't have to be dimensionally accurate or even very neat. You then turn the sketch into a profile with the ADPROFILE command, and Designer automatically applies constraints that clean up your sketch (photo 1). In the process, Designer makes some assumptions about the intended shape of the sketch. For example, it adjusts lines that almost touch, so that they do touch; it makes lines that are nearly vertical or horizontal, exactly vertical or horizontal; and it makes arcs that are nearly tangential to lines, exactly tangential to those lines. In some cases, the assumptions that Designer makes are incorrect, but you can override them manually.

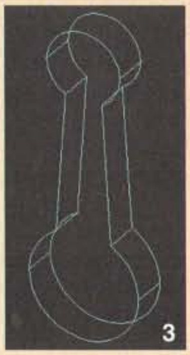

1

After you turn a sketch into a profile, you must apply some further constraints and dimensions to achieve the shape you really want. If a profile is underconstrained (i.e., if you do not give a profile all the constraints and dimensions that are required to achieve the desired shape), then there are no guarantees that Designer won't turn the profile into something unrecognizable the next time you change a dimension.

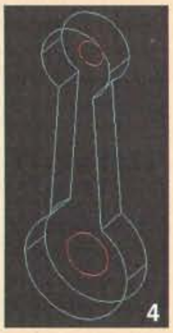


2

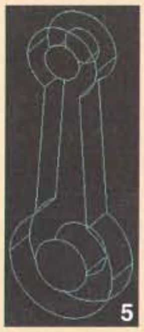
Fully constraining a profile can be a tedious job. One reason is that the dimensions and constraints that are necessary to accomplish the task are not obvious. In the connecting rod example, in addition to adding the required dimensions, I had to constrain the top and bottom arcs so that they had the same *X* value, and I had to set the dimensions of the lines so that they had the same *Y* value (photo 2).


3

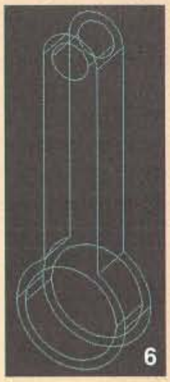
Once you fully constrain the profile, you can turn it into a feature. In the rod example, this is a simple extrusion (photo 3). At this point, the part is a solid model, although it is not yet complete; the rod still needs journal holes. You add the holes as sketches (photo 4), turn them into profiles, constrain them to be concentric to the ends of the rod, and then subtract them as extrusions from the base feature (photo 5).


4

Profiles must be constrained with respect to the base feature. This is where feature-based modeling departs from simple solid modelers, such as AME (the AutoCAD Modeling Extension). Although it might initially seem like a restriction, this requirement lets you build a part with little regard to what its final dimensions will be. In the case of the rod, its overall length, width, and end diameters can be changed just by updating their dimensions (photo 6). From a design perspective, this is an advantage, because it lets you design parts before you finalize their dimensions.

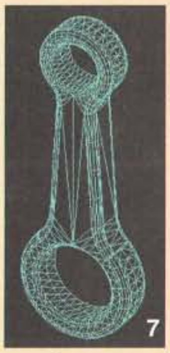

5

After you have established the basic features of a part, you can add fillets and chamfers (i.e., beveled edges). On the rod, I added chamfers in the journal holes and fillets at the base and top of the shank and around the outer edges (photo 7). To show what the rod looks like, I asked Designer to apply a mesh to its surface and render it, which created the image shown on page 201.


6

Because Designer parts are solid models, the program is able to calculate their mass properties. You use the ADMASSPROP command in Designer to display a dialog box listing a part's mass, volume, center of gravity, principal axes, and moments of inertia. An entry field lets you specify the density of the material. All the entries in this dialog box have no default unit of measurement, so they are based on whatever units you used to create the part.

Once you have essentially completed a part, Designer has the capability to create a multiview drawing from it. The drawing can incorporate orthogonal and isometric views, as well as sections.


7

An important characteristic of Designer is that the part and the drawing are bidirectionally associative. This means that any change you make in one is automatically reflected in the other, making the drawing truly intelligent. After a designer or engineer creates a complex part, anyone who has a minimum of AutoCAD experience will be able to modify its dimensions. For example, the rod design could be modified to be any length, with any journal diameter, thickness, and beam width.

From the creation of one part, you can grow a whole family of parts. That, at least, is the theory behind Designer.

this, so the only recourse is to delete some features and then recreate them—not an appealing option, considering it involves redrawing and reconstraining each affected profile. It is possible, however, to make a copy of a profile manually before turning it into a feature. You can retrieve this copy later, if needed.

One Point Oh

AutoCAD Designer is in its first release, and it shows. The program lacks certain refinements that come with maturity. For instance, it has no way of exporting surface data (at least not without going through Autodesk's $1500 AutoSurf program), it lacks the ability to sweep profiles in 3-D or create sculpted surfaces, and it cannot conveniently do sheet-metal or thin-shell design. Even Designer's documentation seems to suffer from first-release problems: It's a bit skimpy and has more than its share of errors.

Despite its warts, Designer is an impressive program overall. Although I encountered difficulties in creating some of my test models, in the end, with the exception of a few complex fillets, Designer was able to create them. No other CAD program in its price range would have been able to do that.

Time will likely be Designer's salvation. Autodesk has issued two updates since the program's initial release, and the company plans to continue updating Designer on a regular basis. Now that AutoCAD Release 13 is shipping, Designer is slated to become more closely integrated with it, so its seams will be less obvious. Autodesk planned to release Designer 1.1 by the time you read this. Its new features include the ability to change constraints at any point in the design process, a set of on-line tutorials on 3-D modeling, and optimized performance (Autodesk claims to have reduced the time required to save some multimegabyte files from roughly 2 hours to 15 minutes).

For mechanical engineers and designers who are already using AutoCAD, buying Designer is almost a no-brainer. It gets them into feature-based modeling for a relatively small investment, and it doesn't require that they learn a new CAD system. Even if Designer proves useful in only a few applications, its cost can easily be justified.

About the Product

AutoCAD Designer 1.0 .....$1500
Autodesk, Inc.
2320 Marinship Way
Sausalito, CA 94965
(800) 964-6432
(415) 332-2344
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For designers and engineers who don't use AutoCAD, however, the buying decision is more complicated. The investment in hardware and training for AutoCAD is not all that different from what you get into with high-end CAD systems. In some cases, paying an extra $12,000 for a high-end CAD system may be good economy, particularly if you're designing products that may produce a few million dollars in revenue to your company. On the other hand, it may be better economy to buy four times as many AutoCAD Designer seats and let four times as many engineers and designers have access to parametric feature-based modeling technology.

Chances are, future versions of Designer will evolve to be more like the high-end solid modelers. For now, it occupies a unique price/performance niche that should appeal to a wide range of users. ■

Evan Yares is the principal consultant at Design Automation Systems in Phoenix, Arizona. You can reach him on the Internet at 5300.1771@compuserve.com or on BIX c/o "editors."

Is AutoCAD Designer a Baby Pro/Engineer?

Since the day AutoCAD Designer was announced, the most common question about it has been whether it is a baby Pro/Engineer. It's a fair question to ask, and the answers are straightforward.

Pro/Engineer is a high-end CAD system from Parametric Technology Corp. (Waltham, MA). Over the past several years, the software has gained a large share of the high-end CAD market, and rightfully so. It is an excellent modeler, with the kind of power that manufacturers need for designing and building complicated products. A typical suite of Pro/Engineer software sells for three to four times the price of a complete AutoCAD Designer setup. If Designer is able to provide a significant subset of Pro/Engineer's capabilities at such a large price advantage, the folks at PTC may have something to worry about.

To see how Designer stacks up against Pro/Engineer, I spent an afternoon at the local PTC office in Phoenix. I went armed with a sketch pad and a few notes on how I wanted to construct my test model, an automotive connecting rod. Rather than starting with a drawing and seeing if the applications engineer could re-create it, I wanted to test Pro/Engineer's conceptual design abilities. The test machine was a Silicon Graphics Indy workstation, with extreme graphics and 32 MB of RAM.

As you might expect, Pro/Engineer had no major problems creating my test connecting rod. At the same time, however, it was not orders of magnitude faster than Designer, and it, too, ran into some design dead ends. Twice during the design process, the PTC applications engineer had to delete existing features because they prevented him from continuing. Once, he had to reorder some features to proceed.

As I noted, Designer had problems generating complex fillets on some of the test parts I built. Pro/Engineer had no such problems and was able to handle whatever wicked geometric tricks I threw at it.

An essential question for engineers is whether the tools they use can solve the problems they have. In short, it doesn't matter how good your hammer is if you really need a screwdriver. Designer can create a wide class of parts but not all parts. It is just not as robust as its higher-end competitors, such as Pro/Engineer. Even though Designer can do an acceptable job modeling a simple connecting rod, Pro/Engineer is capable of modeling not only the connecting rod but the entire engine as well.

For this article, I used Pro/Engineer as an example of a typical high-end CAD system; it is by no means the only example. Companies such as Structural Dynamics Research (Milford, OH), Computervision (Bedford, MA), and Intergraph (Huntsville, AL) offer workstation-based products with similar capabilities. Also, Manufacturing and Consulting Services (Scottsdale, AZ) offers a high-end package that runs under DOS using a 32-bit extender.

For the moment, the folks at PTC (and the other high-end CAD vendors) have nothing to worry about with Designer, other than the fact that some prospective customers might mistake it for a baby Pro/Engineer. That it clearly is not.

62 BIG, BEAUTIFUL COLOR MONITORS

Once you convert from a 15-inch to a larger-size monitor, you're spoiled for life, with no regrets

ANTHONY J. LENNON

Large-screen, high-resolution color monitors are more than luxurious; they're rapidly becoming a necessity for many business applications. The larger the monitor and the greater the resolution, the more cells in a spreadsheet or windows in a GUI you'll see. For serious CAD work, 20- or 21-inch monitors are a must. They're also well suited to desktop publishing, because they can display a two-page spread. Another excellent reason to purchase a large-screen monitor is if you give group presentations. We tested 62 monitors, ranging from 17 to 21 inches, that offer the necessary resolution and refresh rates to take full advantage of today's GUIs.

Using mechanical precision-testing devices and software tools, we searched for the best in the 17-, 20-, and 21-inch categories. We put each monitor through a battery of over 40 visual inspections to measure image quality, sharpness, contrast, convergence, legibility, and distortion. We also evaluated the ease of setup, the controls, and the documentation. Finally, we determined how much power each monitor consumes in active, idle, and sleep modes.

The average MSRP (manufacturer's suggested retail price) of the 17-inch monitors is $909, close to $1300

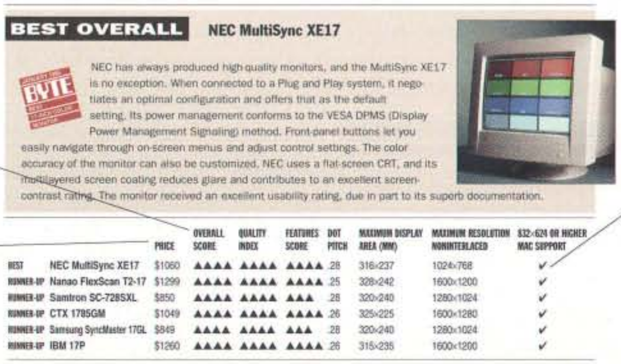
How to use this guide

We selected the best color monitors by combining the test results of display quality, usability features, controls, design, and power consumption. Our test equipment includes software diagnostics, hardware tools, and subjective evaluation. Each category has a different weighting system to arrive at the final scores.

We base overall scores on a weighted average of scores for image quality, sharpness, convergence, contrast, distortion, and legibility. Higher numbers indicate better quality.

The prices listed are MSRP. Street prices may be as much as two-thirds lower.

If the column for Mac 16-inch or higher resolution is checked, the monitors may also support 1152×870 and 640×480 pixels, as well as 832×624 pixels.



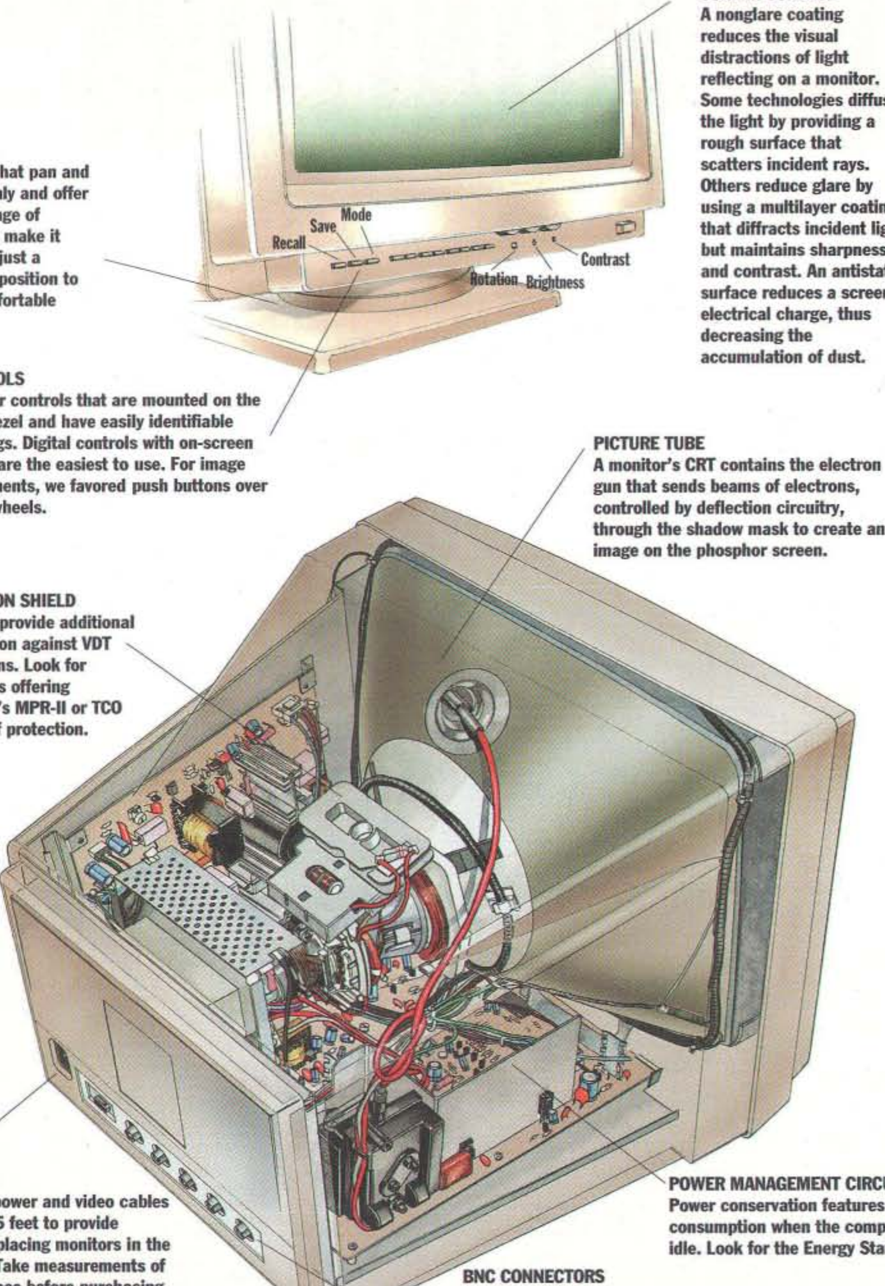
BEST OVERALL **NEC MultiSync XE17**

NEC has always produced high-quality monitors, and the MultiSync XE17 is no exception. When connected to a Plug and Play system, it negotiates an optimal configuration and offers that as the default setting. Its power management conforms to the VESA DPMS (Display Power Management Signaling) method. Front-panel buttons let you easily navigate through on-screen menus and adjust control settings. The color accuracy of the monitor can also be customized. NEC uses a flat-screen CRT, and its multilayered screen coating reduces glare and contributes to an excellent screen-contrast rating. The monitor received an excellent usability rating, due in part to its superb documentation.

		PRICE	OVERALL SCORE	QUALITY INDEX	FEATURES SCORE	DOT PITCH	MAXIMUM DISPLAY AREA (MM)	MAXIMUM RESOLUTION NONINTERLACED	832×624 OR HIGHER MAC SUPPORT
BEST	NEC MultiSync XE17	$1060	▲▲▲▲	▲▲▲▲	▲▲▲▲	.28	316×237	1024×768	✓
RUNNER-UP	Nanao FlexScan T2-17	$1299	▲▲▲▲	▲▲▲▲	▲▲▲▲	.25	328×242	1600×1200	✓
RUNNER-UP	Samtron SC-728SXL	$850	▲▲▲▲	▲▲▲▲	▲▲▲	.28	320×240	1280×1024	✓
RUNNER-UP	CTX 1785GM	$1049	▲▲▲▲	▲▲▲▲	▲▲▲▲	.26	325×225	1600×1280	✓
RUNNER-UP	Samsung SyncMaster 17GL	$849	▲▲▲▲	▲▲▲▲	▲▲▲	.28	320×240	1280×1024	✓
RUNNER-UP	IBM 17P	$1260	▲▲▲▲	▲▲▲▲	▲▲▲▲	.26	315×235	1600×1200	✓

PHOTOGRAPHY: STEVE BELKOWITZ © 1995

Behind the Big Screen



SCREEN SURFACE
A nonglare coating reduces the visual distractions of light reflecting on a monitor. Some technologies diffuse the light by providing a rough surface that scatters incident rays. Others reduce glare by using a multilayer coating that diffracts incident light but maintains sharpness and contrast. An antistatic surface reduces a screen's electrical charge, thus decreasing the accumulation of dust.

PEDESTAL
Monitors that pan and tilt smoothly and offer a good range of movement make it easy to adjust a monitor's position to allow comfortable viewing.

CONTROLS
Look for controls that are mounted on the front bezel and have easily identifiable markings. Digital controls with on-screen menus are the easiest to use. For image adjustments, we favored push buttons over thumbwheels.

PICTURE TUBE
A monitor's CRT contains the electron gun that sends beams of electrons, controlled by deflection circuitry, through the shadow mask to create an image on the phosphor screen.

EMISSION SHIELD
Shields provide additional protection against VDT emissions. Look for products offering Sweden's MPR-II or TCO levels of protection.

CABLING
You'll need power and video cables longer than 5 feet to provide flexibility in placing monitors in the workspace. Take measurements of your workspace before purchasing a large monitor and make sure the wiring setup will be convenient and safe.

POWER MANAGEMENT CIRCUITRY
Power conservation features reduce energy consumption when the computer system is idle. Look for the Energy Star logo.

BNC CONNECTORS
In monitors with high horizontal scanning frequencies, BNC connectors provide shielding between the video input and the signal lines.

JANUARY 1995 BYTE BEST LARGE-SCREEN COLOR MONITORS BEST

17-INCH MONITORS

NEC MultiSync XE17

The NEC tradition continues with the introduction of a line of high-quality monitors that includes the MultiSync XE17. This unit stands out for its excellent screen contrast and efficient internal power management system. The monitor is Microsoft Plug-and-Play-compatible. On-screen menus make using its advanced digital controls a breeze.

PAGE 206

20- AND 21-INCH MONITORS

Nanao FlexScan F760i-W

The Nanao offers excellent overall display quality and earns the third-highest power rating in its class. The monitor excels in our legibility and image-quality tests and exhibits relatively small amounts of distortion and misconvergence. It provides an automatic on/off control and has a combination of LED lamps, push buttons, and an adjustment knob on its front panel. There are two ways to adjust color: with sophisticated controls for experienced users and with the easy-to-use Colorific color-calibration software.

PAGE 212

less than the average MSRP ($2243) of the 20- and 21-inch monitors. The ETC Computer ViewMagic CA-1765CPL and ViewMagic CA-1765SPL were the least expensive monitors we tested at $659. The Philips Brilliance 21A Model 2130DC carried the most expensive price tag of $2999.

Large-scale monitors are heavy. The average weight for a 17-inch monitor is 46 pounds, and the average 20- or 21-inch monitor weighs 73 pounds. They also consume voluminous desk space and a lot of wattage in active mode (116 W for a 20- or 21-inch model and 90.9 W for a 17-inch model). But all the 20- and 21-inch monitors and all but two of the 17-inch ones (the Orchestra Tuba and the TVM AS 6A) are Energy Star recipients, meaning they consume 30 W or less in a low-power state.

One common aspect of many of the monitors is the picture-tube manufacturer. Our entire test sample of 62 monitors, from 33 different vendors, represents only six picture-tube manufacturers (Hitachi, Matsushita, Mitsubishi, Toshiba, Sony, and NEC). Hitachi manufactured 58 percent of the total. Differences in individual tubes and electronics, such as the microprocessors that handle incoming video signals, help differentiate quality among our test sample.

ILLUSTRATION: BRUCE SANDERS © 1995

DO YOUR EYES A FAVOR

17-INCH MONITORS

If you spend more than four hours a day in front of a 15-inch monitor, consider moving up to a 17-inch monitor with better resolution. The higher resolution will increase your viewing real estate, and the larger screen will make the images larger, so you'll be able to see those additional spreadsheet cells. A high-refresh rate reduces flicker and will be easier on your eyes. We tested 44 17-inch monitors. Prices ranged from $659 to $1299.

About one-half of the 17-inch monitors have maximum noninterlaced resolutions of 1280 by 1024 pixels. Most of the others support higher noninterlaced resolutions (1600 by 1200 or 1600 by 1280 pixels). The exceptions are the NEC, Radius, and Panasonic units, which are limited to a maximum resolution of 1024 by 768 pixels. We believe that 1024- by 768-pixel resolution on a 17-inch monitor provides excellent viewing. As the resolution increases, text and objects get smaller, so you would need to be sharp-eyed to enjoy working at resolutions of 1280 by 1024 pixels or higher on this size screen.

All monitors except two are Energy Star recipients and all but eight provide internal power management systems. All meet Sweden's MPR-II standards for VDT emissions. Several carry FCC Class A ratings and are not recommended for home use; they may cause interference with TV reception.

Controls range from basic contrast and brightness to more sophisticated features such as degauss and side convergence, or pincushioning. On most, you can adjust the color to some extent. Sixteen of the monitors provide on-screen menus for image adjustments. All but four monitors support at least one Macintosh mode.

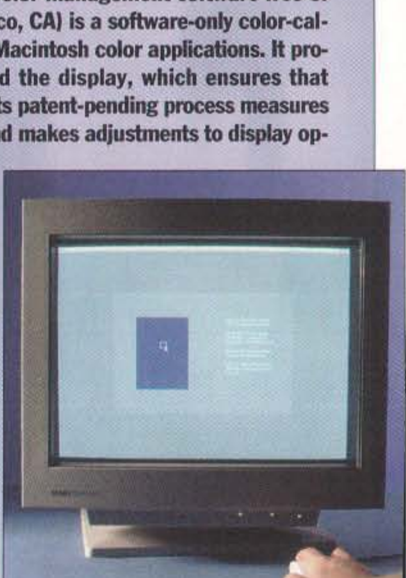
Warranty and support policies often separate major monitor manufacturers from second- and third-tier vendors. Make sure you understand the service policies before you purchase a monitor.

The Best Overall winner, the NEC MultiSync XE17, is Microsoft Plug-and-Play-compatible. This means that a Plug and Play computer system can communicate with the XE17 to identify available setup options that both devices support. A list of optimal configuration options pops up, and the drivers will be included in the operating system—you don't need to install them. The XE17 offers excellent contrast, but its overall display-quality score is only slightly above average, due to its relatively low distortion index. An efficient internal power management system, coupled with above-average features and excellent usability propelled this unit to the number-one rating.

Two Nanao models placed among the top in the 17-inch category. The FlexScan T2-17 ($1299) uses a Sony picture tube, and it excelled in the DisplayMate image-

COLORIFIC COLOR MANAGEMENT SOFTWARE

In addition to sophisticated digital color controls, some high-end monitor manufacturers (e.g., Nanao) are offering Colorific color management software free of charge. Colorific (Sonnetech, Ltd., San Francisco, CA) is a software-only color-calibration system that supports all Windows and Macintosh color applications. It provides communication between the printer and the display, which ensures that the displayed colors match the printed output. Its patent-pending process measures the individual characteristics of your monitor and makes adjustments to display optimum colors. Adjustments accommodate environmental variables such as room lighting, monitor brightness settings, and variations in different video cards. Colorific provides the functionality of costly hardware calibration devices used by graphics professionals and can cut costs by reducing trial-and-error draft printing.


Colorific's gamma screens synchronize color brightness with incoming voltage.

Colorific works with all color monitors and virtually any graphics program, format, or adapter. You are led through a series of choices that determine the color space (i.e., the mathematical description of the monitor's color-rendering characteristics). Template cards and on-screen color combinations guide you through the process. When the process is complete, the utility will create a profile of your monitor and measure it against an international standard for perfect color. You can then optionally reset the monitor to a more accurate set of colors. Once settings are complete, they are saved until you change them. Colorific functions at the operating-system level and requires no special commands. If your scanner does not provide color correction, Colorific will let you correct the color of the scanned input on your monitor.

Colorific for Windows incorporates the Kodak Precision color management system standard for color rendering. Kodak Device Color Profiles are available for most commonly used printers; additional profiles are available from Sonnetech. Colorific for Mac includes Apple's ColorSync color management utility and works with every ColorSync-compatible printer, including Adobe PostScript Level 2 printers.

Imagine this: Once every 15 seconds someone in the USA buys a new CTX color monitor.

That's a million last year alone – more even than sold under big names like NEC, Sony, IBM and Mitsubishi*.

And that's before the international experts started raving about our bigger, new, high-performance 1765GM and 1785GM 17-inch "green" monitors:

"Best 17-in. monitor" (Monthly PC Magazine, Japan). *"Best overall performance"* (Soft & Micro Magazine, France). *"One of the best monitors...bright, sharp display and excellent colors"* (Windows Magazine, Sept. '94). *"Symbol of Excellence Award"* (CETDC/ Business Week Asia, Taiwan). *"Best Display Products"* (Computex/Byte, Taiwan).

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*BYTE magazine found the Sceptre 15-inch color monitor to be the "best overall" in performance and quality. Better than NEC, IBM, Mitsubishi, and Zenith in screen quality, cost, power conservation and distortion tests.

PC Digest rated Sceptre's CC-615GL #1 after combining scores for quality,

PC Digest
RATINGS REPORT

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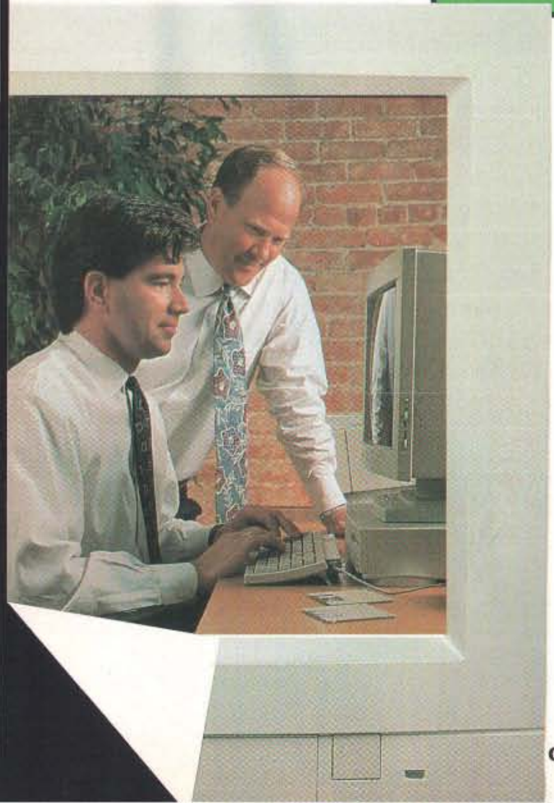

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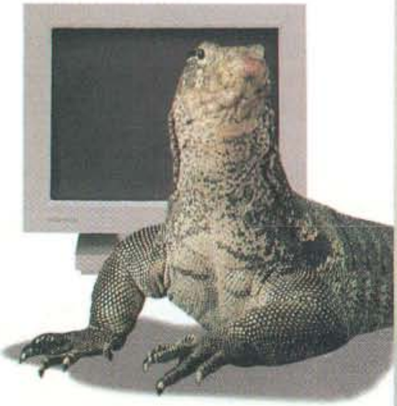

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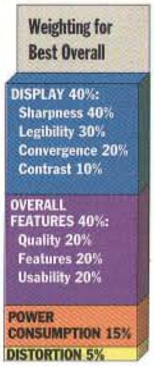
Circle 138 on Inquiry Card (RESELLERS: 139).

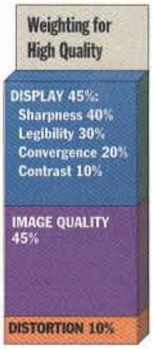
Sceptre 17" CC-617GL

quality test. The FlexScan F560i-W ($1279) uses a Toshiba picture tube, offers above-average image quality, provides higher contrast, and exhibits less distortion than the FlexScan T2-17. The FlexScan F560i-W's front control panel is more sophisticated than the FlexScan T2-17's. However, you can access the FlexScan T2-17's advanced features using an on-screen menu. The two 17-inch Nanao monitors offer superb features and above-average usability—they should, considering their price tags.



The Samtron SC-728SXL ranks third overall and earned the best overall image-quality rating. This unit was practically free from misconvergence, and only four other monitors received a better power rating.

Both CTX International 1785GM and the 1765GM monitors placed well in the 17-inch class. The 1785GM exhibits an extremely sharp Hitachi display with a .26-mm dot pitch. The 1765GM offers better contrast and exhibits less misconvergence with its .27-mm dot-pitch Matsushita picture tube. The stylish monitors look identical from the front.



The Sony Multiscan 17se is second only to the Samtron SC-728SXL in our High Quality category. Sony's Trinitron display technology produces vibrant, fully saturated colors. The Multiscan 17se's three factory preset color modes and one user-adjustable color mode let you adjust on-screen colors to match printouts.

KEY	
Excellent ▲▲▲▲	Good ▲▲▲
Fair ▲▲	Poor ▲

BYTE BEST 17-INCH

New and improved from NEC

BEST OVERALL **NEC MultiSync XE17**

JANUARY 1995 BYTE BEST 17-INCH COLOR MONITOR

NEC has always produced high-quality monitors, and the MultiSync XE17 is no exception. When connected to a Plug and Play system, it negotiates an optimal configuration and offers that as the default setting. Its power management conforms to the VESA DPMS (Display Power Management Signaling) method. Front-panel buttons let you easily navigate through on-screen menus and adjust control settings. The color accuracy of the monitor can also be customized. NEC uses a flat-screen CRT, and its multilayered screen coating reduces glare and contributes to an excellent screen-contrast rating. The monitor received an excellent usability rating, due in part to its superb documentation.

		PRICE	OVERALL SCORE	QUALITY INDEX	FEATURES SCORE	DOT PITCH	MAXIMUM DISPLAY AREA (MM)	MAXIMUM RESOLUTION NONINTERLACED	832×624 OR HIGHER MAC SUPPORT
BEST	NEC MultiSync XE17	$1060	▲▲▲▲	▲▲▲▲	▲▲▲▲	.28	316×237	1024×768	✓
RUNNER-UP	Nanao FlexScan T2-17	$1299	▲▲▲▲	▲▲▲▲	▲▲▲▲	.25	328×242	1600×1200	✓
RUNNER-UP	Samtron SC-728SXL	$850	▲▲▲▲	▲▲▲▲	▲▲▲	.28	320×240	1280×1024	✓
RUNNER-UP	CTX 1785GM	$1049	▲▲▲▲	▲▲▲▲	▲▲▲▲	.26	325×225	1600×1280	✓
RUNNER-UP	Samsung SyncMaster 17GL	$849	▲▲▲▲	▲▲▲▲	▲▲▲	.28	320×240	1280×1024	✓
RUNNER-UP	IBM 17P	$1260	▲▲▲▲	▲▲▲▲	▲▲▲▲	.26	315×235	1600×1200	✓

A remarkable image from Samtron

HIGH QUALITY **Samtron SC-728SXL**

The Samtron's high quality ranking is due mainly to its excellent performance in the convergence test. The unit's average was only .02 mm (the Philips and MegaImage models were its closest competitors at .029 mm). The Samtron features antistatic CRT coating, flat-screen CRT technology, and above-average contrast. Although it employs dynamic focusing, its image sharpness was only average. And it performed below the norm in the legibility test. The Script font was not legible below 14 points (13 points was the average for 17-inch monitors), and the Times Roman and Arial fonts were not readable when their point size was smaller than six (the average being five points).

		PRICE	OVERALL SCORE	QUALITY INDEX	FEATURES SCORE	DOT PITCH	MAXIMUM DISPLAY AREA (MM)	MAXIMUM RESOLUTION NONINTERLACED	832×624 OR HIGHER MAC SUPPORT
BEST	Samtron SC-728SXL	$850	▲▲▲▲	▲▲▲▲	▲▲▲	.28	320×240	1280×1024	✓
RUNNER-UP	Sony Multiscan 17se	$1250	▲▲▲	▲▲▲▲	▲▲▲	.25	300×225	1600×1200	✓
RUNNER-UP	Dyna Micro MON-172GLR	$699	▲▲▲	▲▲▲▲	▲▲▲	.28	300×225	1280×1024	
RUNNER-UP	CTX 1765GM	$999	▲▲▲	▲▲▲▲	▲▲▲	.27	325×245	1280×1024	✓
RUNNER-UP	Megatron MegaImage	$679	▲▲▲	▲▲▲▲	▲▲▲	.28	300×225	1280×1024	✓
RUNNER-UP	ADI MicroScan 5EP	$769	▲▲▲	▲▲▲▲	▲▲	.28	320×240	1280×1024	

Low cost, low power, high quality

LOW COST (UNDER $800) **ADI MicroScan 5EP**

With its $769 MSRP, the ADI MicroScan 5EP finished as our Low Cost winner. It offers higher contrast and produced a lower distortion index than that of the Samtron SC-728SXL. The MicroScan 5EP's power rating indicates the efficiency of the system's internal power management system; however, its .28-mm dot pitch, lower-than-average number of user-definable modes (only eight), and lack of an on-screen menu adversely affected its features rating. Digital contrast and brightness controls are located on the front of the unit; more sophisticated controls (i.e., horizontal phase and width, vertical size and shift, and degauss) are located behind a protective cover.

		PRICE	OVERALL SCORE	QUALITY INDEX	FEATURES SCORE	DOT PITCH	MAXIMUM DISPLAY AREA (MM)	MAXIMUM RESOLUTION NONINTERLACED	832×624 OR HIGHER MAC SUPPORT
BEST	ADI MicroScan 5EP	$769	▲▲▲	▲▲▲▲	▲▲	.28	320×240	1280×1024	
RUNNER-UP	Orchestra Tuba-II	$795	▲▲▲	▲▲▲▲	▲▲▲▲	.26	330×241	1600×1200	
RUNNER-UP	Megatron MegaImage	$679	▲▲▲	▲▲▲▲	▲▲▲	.28	300×225	1280×1024	✓
RUNNER-UP	NSA Hitachi Super 17s	$795	▲▲▲	▲▲▲▲	▲▲▲	.26	316×237	1280×1024	✓

How We Tested

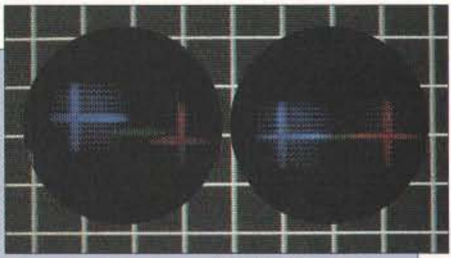
We tested 17-inch monitors that support a noninterlaced resolution of at least 1024 by 768 pixels at a refresh rate of 70 Hz, as well as 20- and 21-inch monitors that support a noninterlaced resolution of 1280 by 1024 pixels at 60 Hz. We tested all monitors using BNC connectors (if they were available).

We use a Klein optical gauge to measure convergence and a Tektronix luminance photometer to measure screen contrast. On the software side, Sonera Technologies' DisplayMate Professional and NSTL's monitor-testing software let us make detailed evaluations of image quality.

BYTE conducted more than 40 separate visual inspections on each monitor, using software-testing tools. We performed all Windows-based tests at standard resolutions for each class of monitor (1024 by 768 pixels at a 72-Hz vertical refresh rate for 17-inch monitors and 1280 by 1024 pixels at a 60-Hz vertical refresh rate for 20- and 21-inch monitors). As our test-bed, we used Graphics Pro Turbo video adapters (with 4 MB of VRAM) by ATI Technologies and Compaq Deskpro 66M computers.

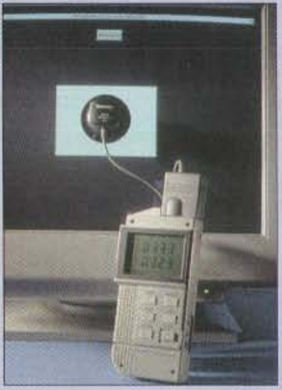
TESTING TOOLS

KLEIN CONVERGENCE GAUGE



Looking through the Klein convergence gauge.

This gauge works on the principle of optical reconvergence, measuring the amount of reconvergence necessary to define the convergence error present. Misconvergence displays itself as white areas or lines that have a tinge of RGB. The Klein model CM7AG gauge contains three prisms, each passes one of the phosphor colors of the CRT. The stationary center prism is a reference; the outer two prisms shift. Rotating the outer prism makes the image beneath it appear to shift. The amount of shift is calibrated in millimeters. The gauge scales read the convergence error present when the three colors of the image shift into optical reconvergence.



The Lumacolor's sensor head sticks directly to the screen with a suction cup.

TEKTRONIX J17 LUMACOLOR PHOTOMETER AND SENSOR HEAD

The J17 is a hand-held digital photometer, radiometer, and colorimeter. The backlit unit features auto-ranging, auto-zero, readings in English or metric units, and an RS-232D interface. The J17 supports the fully interchangeable J1800 series of heads that provide the ability to make a variety of light measurements. We used the J1820 chromaticity head for taking chromaticity measurements of displays, ambient-lighting measurements, and light-source measurements. Luminance values are initially displayed in cd/m^2 but can be converted to foot-lamberts with the press of a button.

DISPLAY QUALITY

For measuring overall image quality, we used three monitors of low, middle, and high quality as a control set: They all displayed the same image.

To measure image sharpness, we used an NSTL utility that produces 1- and 2-pixel-thick RGB boxes at the outside edges of the screen. We examined how well each monitor displays each box and black line. A second series of images measured the monitors' abilities to display fine vertical and horizontal lines.

Distortion manifests itself as oddly shaped screen images. Testers measure the lengths of a series of lines displayed on the monitor, and DisplayMate calculates a percentage of distortion.

The legibility test offers a real-world measurement. Testers decided at which size text was both readable and legible from a standard reading distance of 24 inches.

We determined the overall display-quality score by calculating the weighted average of the image-sharpness (40 percent), contrast-ratio (10 percent), convergence (20 percent), and legibility (30 percent) tests. We combined this score with the image-quality (45 percent each) and the distortion (10 percent) scores.

Using a digital multimeter connected to the power system of the monitor, we measured power consumption when each monitor displayed a full Windows screen and when the screen was blanked. For VESA DPMS-compliant (Display Power Management Signaling) monitors, we measured power consumption in suspend mode.

FEATURES

The features we judged included the number of factory preset and user-definable modes, type of video connectors, maximum usable screen area, weight, maximum resolution, power management, and electromagnetic radiation emission specifications.

For Best Overall winners, we calculated the weighted average of the image sharpness (40 percent), contrast ratio (10 percent), convergence (20 percent), and legibility (30 percent) tests. We weighed this score equally against the total for image quality, features, and usability (20 percent each). Distortion (5 percent) and power consumption (15 percent) are the remaining two components. The 17-inch monitors that priced under $800 and the 20- and 21-inch monitors that priced under $2000 were eligible for the Low Cost category.

Contributors

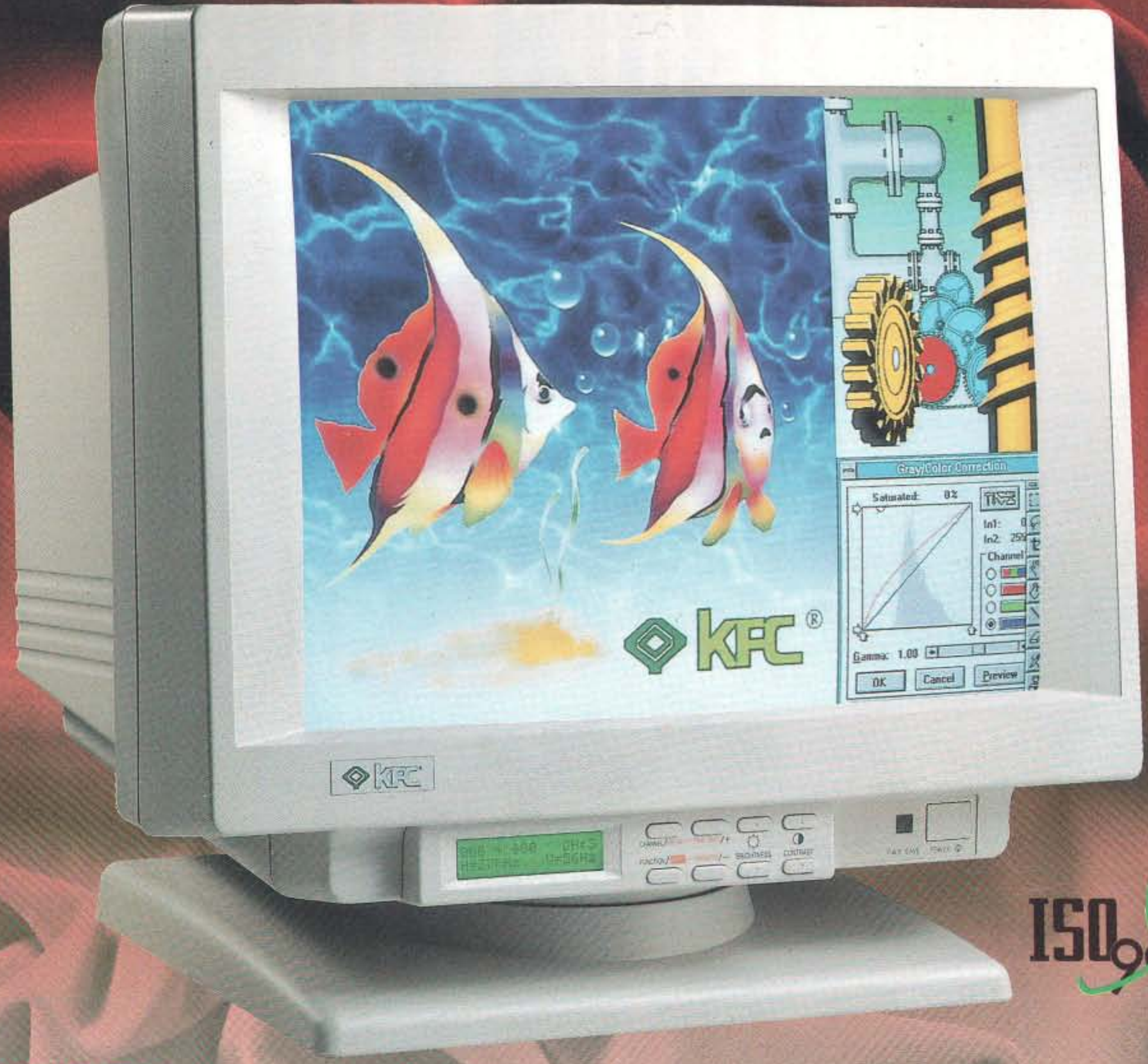
Anthony J. Lennon, *Project Manager NSTL, evaluates portables, systems, peripherals, and network hardware.*

Siva Kumar, *Technical Analyst/NSTL, specializes in hardware and network-operating-systems testing.*

Maggi Bender, *Tester/NSTL.*

The Lab Report is an ongoing collaborative project between BYTE magazine and National Software Testing Laboratories (NSTL). BYTE magazine and NSTL are both operating units of McGraw-Hill, Inc. Contact the NSTL staff on the Internet at editors@nstl.com; at NSTL, Inc., Plymouth Corporate Center, Plymouth Meeting, PA 19462; or at (610) 941-9600. Contact BYTE on the Internet or BIX at editors@bix.com or at (603) 924-9281.

The Green Monitors From KFC®



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JANUARY 1994 BYTE BEST VALUE GENERAL BUSINESS COLOR MONITOR

CA 1507 was awarded the "Best Value: General Business Color Monitor" by BYTE Magazine in the January 1994 BYTE/NSTL Lab Report

CA1718 was the Best Value Runner-up for Spreadsheet and Graphics Color Monitor in BYTE Magazine's January 1994 BYTE/NSTL Lab Report.

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UPSCALE DISPLAYS

20- AND 21-INCH MONITORS

If you conduct group presentations, design large and complex CAD drawings, run desktop publishing applications, or edit color graphics, you should consider a 20- or 21-inch monitor. At 800- by 600-pixel resolution, a full-screen presentation would be clear even from the back of a conference room. A number of the products also feature BNC video connectors, which let you chain several monitors together.

These large-scale monitors are expensive and demand a premium in desk space. They are also power-hungry devices. In active mode, the monitors consume an average of 116 W compared to an average of 90.9 W for the 17-inch test units. However, they are all Energy Star recipients. All the units also meet Sweden's MPR-II standards for CRT emissions, but only seven of the products carry FCC Class B ratings.

The Philips Brilliance 21A and Nanao FlexScan F760i-W finish with nearly identical overall ratings. The Philips, which lists for over $900 more than the Nanao, finished with the highest overall display-quality rating.

The NSA Hitachi SuperScan Elite 21 finished slightly behind the Nanao FlexScan F760i-W and Philips Brilliance 21A in the overall rankings. Because the unit contains an efficient internal power management system, and it also earned the third-highest display-quality rating. Its MSRP of $1995 made it the Low Cost winner. It comes with Windows-based software that lets you control the monitor's settings using your mouse via an RS-232 port.

The Radius SuperMatch 21*T XL's high overall rank is due mainly to its excellent usability rating. The monitor comes with superior documentation. It also received high marks for its easily adjustable 180-degree tilt-and-swivel range. However, the Radius performed poorly in the legibility test.

Power management is not the ViewSonic 21's strength. However, it is priced under $2000, offers above-average image sharpness (thanks to its dynamic focus circuit), and does not suffer from image distortion. Its contrast ratio is aided by a high-power video amplifier that enhances brightness. The monitor makes use of flat-screen CRT technology and can store up to 21 types of timing.

The Nokia Multigraph 445X provides excellent features and ranks near the top in power management. The Nokia's display wasn't as bright as those of many of the other units, which lowered its contrast ratio. It exhibited slightly higher misconvergence than the norm but provided above-average performance in the remaining display-quality tests. Subpar multilanguage documentation hurt the monitor's usability rating.

The Idek/Iiyama VisionMaster MF-8221 ($1945) is the least expensive of the 21-inch monitors. It has an excellent quality score but only fair usability. In the legibility test, it provided the best-overall performance. The three VisionMaster models also provide excellent quality. The MF-

KEY TERMS

Aperture grill/shadow mask All monitors have an aperture grill or shadow mask, a piece of thin, perforated metal through which electron beams pass before striking phosphors. While most picture tubes use a dot mask, one with very small holes, Sony's Trinitron picture tubes use a mask with long vertical slots. The geometry of the openings of the masks prevent the electron beams from striking the wrong phosphor dots. The electron beam for red is blocked from illuminating blue phosphors by the mask; in other words, the mask creates a shadow over the blue and green dots when the beam for red passes.

Blooming Blooming occurs when the image on a monitor appears to grow in size when that image is brightly illuminated. You will see this most often with bright white characters or objects. Characters become unfocused as the pixels spread and defuse.

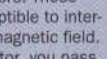
Convergence/misconvergence Monitors use the RGB color model, producing white by illuminating the three phosphor dots of a color triad simultaneously. Convergence is a monitor's ability to precisely illuminate each dot in the triad. This is difficult because the electron beams for RGB must converge exactly on each triad. Misconvergence occurs when the electron beams scan the wrong dots of a triad and manifests itself as colored edges on white objects. High levels of misconvergence appear as shifted colors.

Dot pitch Dot pitch refers to the distance between the centers of RGB phosphor dots that make up the color triad. Smaller distances generally mean greater resolution capability. Comparing a monitor with a .53-mm dot pitch to one with a .28-mm dot pitch is similar to comparing a 9- and 24-pin printer. In products using the Trinitron aperture grill, the dot pitch refers to the center-to-center distance of the vertical grill openings.

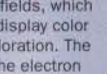
Horizontal frequency This indicates the number of horizontal lines illuminated on-screen in 1 second. Increasing resolution requires greater horizontal frequency.

Vertical refresh rate The speed at which the electron beams scan across the screen from top to bottom is the vertical refresh rate. The beam of electrons sweeps across the phosphor dots a line at a time. The phosphor absorbs the energy of the beam and releases this energy as light. As the energy is used, the light fades. If the beams do not return to the phosphor dots quickly enough, the image starts to fade. This results in a visual effect called flicker. High refresh rates reduce flicker and keep the image sharp and stable. As resolutions increase, the need for higher refresh rates also goes up. Higher resolutions require more and smaller pixels, and to prevent image degradation, they must be refreshed more often.

Interlaced/noninterlaced In interlaced mode, the display image is divided into two fields consisting of either odd or even scan lines. On one pass, the electron beams refresh the even lines, and then on the next pass, they refresh the odd lines. Noninterlaced means the electron beams scan every line of the display on each vertical sweep. Manufacturers developed interlacing as a way of pushing higher resolutions through the narrow bandwidth of early displays and video adapters. Products that support greater signal bandwidth do not need to interlace. You should consider only the maximum noninterlaced resolution when evaluating monitors.



Noninterlaced



Interlaced

Degaussing Strong electromagnets control the deflection of the electron beams used to illuminate phosphors. These electromagnets are susceptible to interference from the earth's magnetic field. As you pan or tilt the monitor, you pass it through these magnetic fields, which can cause the monitor to display color shifts or blotches of discoloration. The degauss control realigns the electron beams and reduces screen discoloration.

Multiscanning vs. fixed frequency A multiscanning monitor has the ability to lock on to virtually any frequency between the high and low limits of its controlling electronics. A fixed-frequency monitor will accept video signals at one of a limited number of combinations that must match the signals the display adapter provides. All the products in this review offer multiple-frequency synchronization.

Resolution The size of the pixels contributes to the sharpness of the image and the amount of an image displayed. Increasing resolution requires more and smaller pixels. Standard VGA resolution is 640 pixels horizontally and 480 pixels vertically. We tested monitors capable of resolutions as high as 1600 pixels by 1280 pixels. Increasing the resolution means sending more data; consequently, monitors offering high resolutions must also provide greater bandwidth. High-resolution modes also require faster refresh rates.

800 by 600 pixels

1280 by 1024 pixels

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	C-1491	C-1591E*	C-1791	C-1792P	C-2192P
Dot Pitch	.28	.27	.28	.27	.25
Maximum Resolution	1280 x 1024	1280 x 1024	1280 x 1024	1600 x 1280	1600 x 1280
PanaPerfect Control System		✓	✓	✓	✓
Warranty	1 Year	1 Year	3 Year CRT 1 Year Full	3 Year CRT 1 Year Full	3 Year CRT 1 Year Full

*Available Spring 1995

Panasonic
Office Automation OA

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*Anti-Glare, Anti-Reflection, Anti-Static.
†Double-Quadrupole Dynamic Astigmatism and Focus

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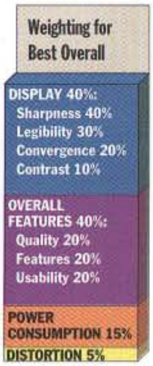
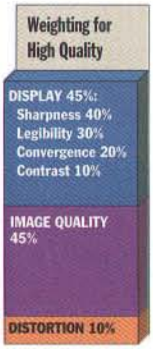
MN3-BY

8221 and MF-8621 contain a power-off sensor that automatically places the monitors in standby mode when no one is in front of them for over an hour. The control buttons are located on a sliding tray that pops out from the base of the unit. The MF-8221 is VESA DPMS-compliant (Display Power Management Signaling). You can adjust the displayed image from up to 3 meters away, using a remote-control unit and the on-screen menu system.



The Mitsubishi Diamond Pro 21T excelled in the image-sharpness test. The monitor uses dynamic-beam forming for focusing, and its CRT is coated with antireflection, antiglare, and antistatic coating. You can adjust the displayed image via a keyboard or mouse, using its serial-interface kit, which comes with a serial-control cable and Diamond Control for Windows software. Low contrast, power ratings, and relatively high misconvergence scores hurt the monitor's overall ranking.



The 20-inch Tatung CM-20MKR incorporates a dark-tinted antiglare tube that reduces eye fatigue and provides the best-overall contrast (about 17 percent higher than its closest competitor). The monitor's efficient power-saving system is second only to that of the 20-inch TVM AS 7G, but its performance in the convergence and distortion tests was poor, and the images weren't sharp.

KEY	
Excellent ▲▲▲▲	Good ▲▲▲
Fair ▲▲	Poor ▲

BYTE BEST — 20- AND 21-INCH

Superior image quality and control

BEST OVERALL **Nanao FlexScan F760i-W**

JANUARY 1995 BYTE BEST 21-INCH COLOR MONITOR

The Nanao uses a flat-screen CRT, dynamic focus, and dynamic-beam spot-control circuitry to reduce distortion and achieve superior image quality. The monitor automatically powers on and off with the PC. A blank screen triggers the power-save mode, and the monitor switches to the lowest power mode after a user-specified time period; after that, only the microprocessor remains active. Sophisticated color controls let you change the white-point temperature setting, color gain, and color contrast of the screen image. After Dark with Ecologic video blanking and Colorific color-calibration software are bundled with the unit.

		PRICE	OVERALL SCORE	QUALITY INDEX	FEATURES SCORE	SIZE	DOT PITCH	MAXIMUM DISPLAY AREA (MM)	MAXIMUM RESOLUTION NONINTERLACED	MAC 16-INCH SUPPORT OR HIGHER
BEST	Nanao FlexScan F760i-W	$2069	▲▲▲▲	▲▲▲▲	▲▲▲▲	21"	.28	403×298	1280×1024	✓
RUNNER-UP	Philips Brilliance 21A	$2999	▲▲▲▲	▲▲▲▲	▲▲▲▲	21"	.28	406×304	1600×1280	✓
RUNNER-UP	NSA Hitachi SuperScan Elite 21	$1995	▲▲▲▲	▲▲▲▲	▲▲▲	21"	.28	406×302	1600×1280	✓
RUNNER-UP	Radius SuperMatch 21*T XL	$2599	▲▲▲▲	▲▲▲▲	▲▲▲	21"	.31	380×285	1600×1280	✓
RUNNER-UP	ViewSonic 21	$1995	▲▲▲▲	▲▲▲▲	▲▲▲▲	21"	.25	402×301	1600×1280	✓

No trade-off for quality

HIGH QUALITY **Philips Brilliance 21A Model 2130DC**

The Philips exhibits the least amount of misconvergence of its class. It has a flat-screen CRT, with antistatic and antireflective coating and provides the top performance in the distortion test. It is second only to the Idek/Iiyama VisionMaster MF-8221 in the legibility test. However, the Philips' contrast ratio is subpar, and it provides only average image sharpness and quality. An LCD displays control messages and diagnostics, and a keyboard lock allows you to temporarily disable the control panel. The monitor stores up to 19 different graphics resolutions, and you can select up to three different white color temperatures.

		PRICE	OVERALL SCORE	QUALITY INDEX	FEATURES SCORE	SIZE	DOT PITCH	MAXIMUM DISPLAY AREA (MM)	MAXIMUM RESOLUTION NONINTERLACED	MAC 16-INCH SUPPORT OR HIGHER
BEST	Philips Brilliance 21A	$2999	▲▲▲▲	▲▲▲▲	▲▲▲▲	21"	.28	406×304	1600×1280	✓
RUNNER-UP	Nanao FlexScan F760i-W	$2069	▲▲▲▲	▲▲▲▲	▲▲▲▲	21"	.28	403×298	1280×1024	✓
RUNNER-UP	NSA Hitachi SuperScan Elite 21	$1995	▲▲▲▲	▲▲▲▲	▲▲▲	21"	.28	406×302	1600×1280	✓
RUNNER-UP	NSA Hitachi SuperScan Supreme 21	$2745	▲▲▲	▲▲▲▲	▲▲▲	21"	.26	406×302	1600×1280	

Excellent quality and a smart price

LOW COST (UNDER $2000) **NSA Hitachi SuperScan Elite 21**

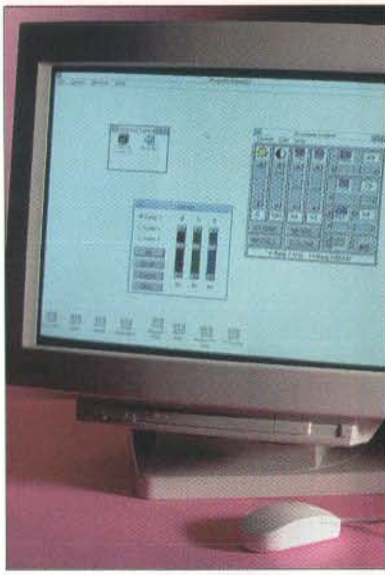
The flat-screen NSA Hitachi SuperScan Elite 21 is an excellent value; it finishes with a similar overall rating to the Philips Brilliance 21A Model 2130DC, which costs over $1000 more. The monitor's overall display quality is excellent. Its performance in the convergence and distortion tests is superior, and it features a dynamic-focus circuit. Sophisticated digital controls are located on the cabinet front, or you can use the mouse or keyboard to adjust the image size, trapezoid, rotation, and side pincushion. You can also adjust RGB color balance. Microprocessor-based preset functions can store 31 sets of geometry settings, including the factory settings.

		PRICE	OVERALL SCORE	QUALITY INDEX	FEATURES SCORE	SIZE	DOT PITCH	MAXIMUM DISPLAY AREA (MM)	MAXIMUM RESOLUTION NONINTERLACED	MAC 16-INCH SUPPORT OR HIGHER
BEST	NSA Hitachi SuperScan Elite 21	$1995	▲▲▲▲	▲▲▲▲	▲▲▲	21"	.28	406×302	1600×1280	✓
RUNNER-UP	ViewSonic 21	$1995	▲▲▲▲	▲▲▲▲	▲▲▲▲	21"	.25	402×301	1600×1280	✓
RUNNER-UP	Idek/Iiyama VisionMaster MF-8221	$1945	▲▲▲	▲▲▲▲	▲▲▲▲	21"	.28	406×304	1600×1280	✓

HONORABLE MENTIONS

The Idek/Iiyama VisionMaster Pro MT-9121 comes with a remote-control unit and an on-screen menu system. You can use the remote control within its slide-out tray or from a distance of up to 3 meters. A warning sounds at 10-, 20-, and 30-minute intervals if you fail to return the remote to its tray. You can also adjust tilt and swivel manually or via the remote control. A lock mode protects against accidental changes to display settings.

If your computer has audio capability, the 17-inch Nokia Valugraph 447L will let you hear voice messages from its loudspeakers, without external audio equipment. It even includes sound balance and volume controls. Corresponding outputs of the computer are connected to left/right inputs on the monitor. If you want to silence the loudspeakers, you can plug headphones into a socket on the side.

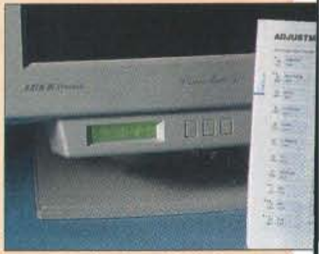


The Mitsubishi Diamond Scan 17FS and the Diamond Pro 21T let you adjust their displays using your mouse or keyboard. To do this, the units must be configured with their serial-interface kits (included with the 21T and as an option on the 17FS). The serial-interface kit has a serial cable and Diamond Control for Windows software that lets you make any of the adjustments found on the control panels (i.e., degaussing, enabling/disabling power management, selecting color temperature, and adjusting RGB gains). NSA Hitachi SuperScan Elite series of monitors also comes with serial control software that offers similar functionality.

Dubious Achievements

The Sceptre Technologies CC-617G and CC-617GL+ monitors have awkwardly placed degauss, brightness, and contrast slide controls. It would be easy to accidentally reset them when adjusting tilt and swivel. The power button is located on the right corner of the units and is difficult to locate if you are not familiar with the monitors. Front digital controls are located on the swivel base. You may need to consult the manual to determine how to access the rotation and pincushion controls.

◄



The Idek/Iiyama VisionMaster MF-8617's LCD panel eliminates many adjustment buttons, which gives the unit a sleek appearance. When you press the main button, the panel displays a menu that you can navigate by pressing the plus and minus keys, a procedure similar to navigating menus on many printers. The problem with the unit's space-saving design is that menu items are abbreviated with three letter codes that you must look up in the documentation. For instance, the code for pincushion adjustment is PCC, and the code for horizontal size is HSC.

◄

The screen display menu on the ETC Computer ViewMagic CA-1765SPL overlays the current screen. Because the menu isn't on a solid background, adjustments are difficult to see, especially from within a GUI, such as Microsoft Windows or X Window System.

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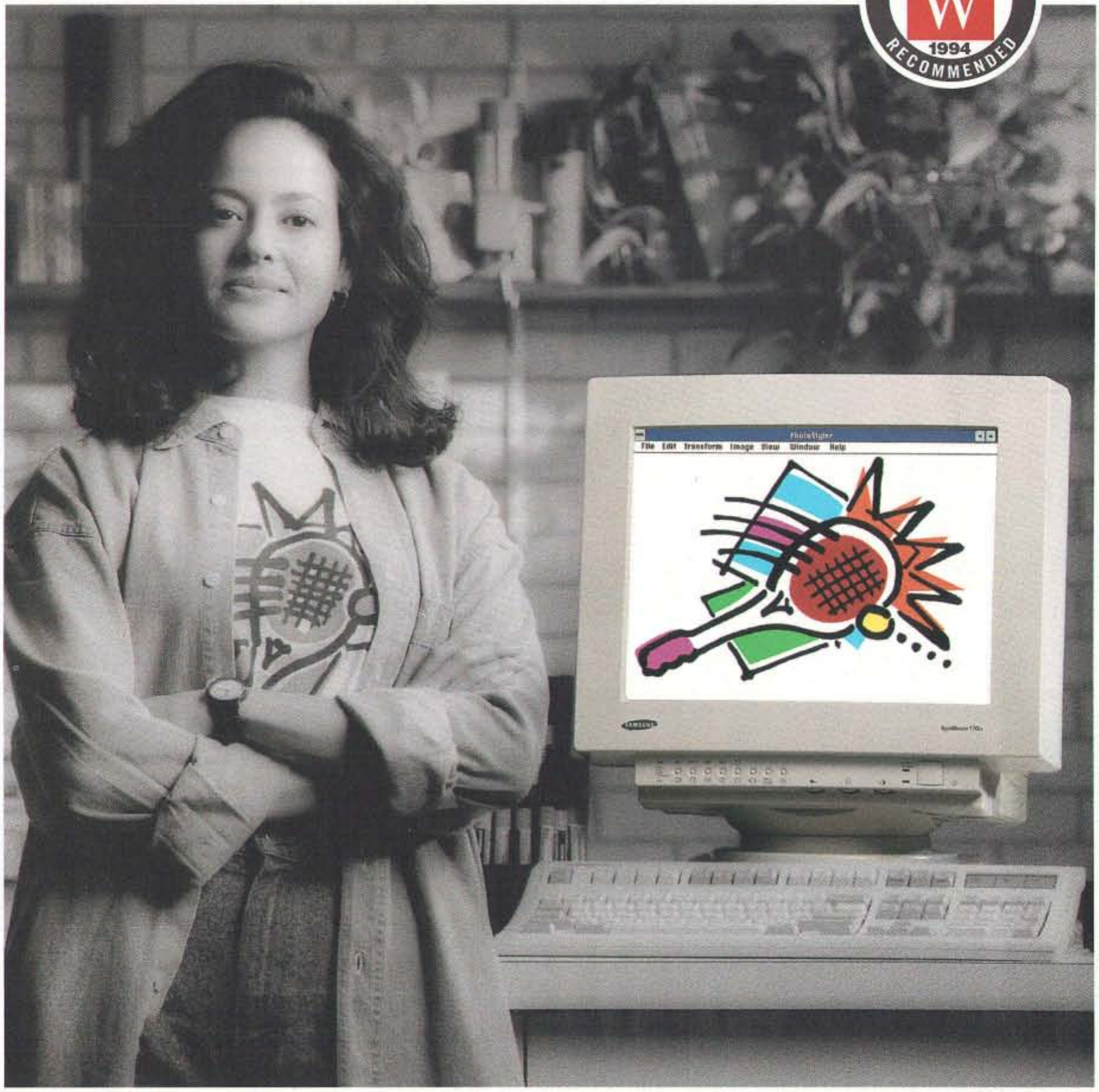
WINDOWS MAGAZINE W 1994 RECOMMENDED



SyncMaster 17GLs

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SyncMaster	14GL	15GL	17GL	17GLs
CRT Size	14"	15"	17"	17"
Dot Pitch	.28	.28	.28	.26
Maximum Resolution	1024 x 768	1024 x 768	1280 x 1024	1600 x 1280
Maximum Refresh Rate at Maximum Res. (Hz)	76	76	60	60
MPR-II (Low Radiation)	•	•	•	•
Power Management	•	•	•	•
Flat Square Screen		•	•	•
On-Screen Programming			•	•
Real Color Control				•
Warranty	2 Years	2 Years	2 Years	2 Years

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		MANUFACTURER	MODEL	PRICE AS TESTED (MSRP)	OVERALL SCORE	QUALITY INDEX	USABILITY INDEX	POWER SCORE	FEATURES SCORE	SCREEN SURFACE	DOT PITCH (MM)/MASK TYPE
17-INCH		ADI Systems, Inc.	MicroScan 5AP	$859	▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲	▲▲▲	NG	.26/dotted
		ADI Systems, Inc.	MicroScan 5EP	$769	▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲	▲▲	NG	.28/dotted
		Amdek	AM/817E	$769	▲▲▲	▲▲▲	▲▲	▲	▲▲▲	NG, AS	.26/dotted
		CTX International, Inc.	1765GM	$999	▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	▲▲▲	All apply	.27/dotted
		CTX International, Inc.	1785GM	$1049	▲▲▲▲	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲▲	All apply	.26/dotted
		Dyna Micro, Inc.	MON-172GLR	$699	▲▲▲	▲▲▲▲	▲	▲▲	▲▲▲	All apply	.28/dotted
		ETC Computer, Inc.	ViewMagic CA-1765CPL	$659	▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲	AG, FS	.26/dotted
		ETC Computer, Inc.	ViewMagic CA-1765SPL	$659	▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲	AG, FS	.26/dotted
		Goldstar U.S.A., Inc.	1725	$900	▲▲▲	▲▲▲▲	▲▲▲	▲▲▲▲	▲▲	NG, AS	.28/dotted
		IBM PC Co.	IBM 17P	$1260	▲▲▲▲	▲▲▲▲	▲▲▲	▲▲	▲▲▲▲	AR, AS	.26/aperture g
		Idek/Iiyama North America	VisionMaster MF-8617	$799	▲▲▲	▲▲▲▲	▲▲	▲▲	▲▲▲▲	AS, AR	.26/dotted
		MAG InnoVision, Inc.	DX17F	$729	▲▲▲	▲▲▲▲	▲▲	▲▲	▲▲▲	NG	.26/dotted
		MAG InnoVision, Inc.	MXP17F	$1299	▲▲▲	▲▲▲▲	▲▲▲	▲	▲▲▲▲	NG, AS	.26/dotted
		Megatron	MegaImage S17MGP	$679	▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	▲▲▲	NG, AS, Silica	.28/dotted
		Mitsubishi Electronics America, Inc.	Diamond Scan 17FS	$1069	▲▲▲	▲▲▲	▲▲▲	▲▲	▲▲▲	AS	.28/dotted
		Nanao USA Corp.	FlexScan F560i-W	$1279	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	AR, AS	.26/dotted
		Nanao USA Corp.	FlexScan T2-17	$1299	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	AR, AS	.25/slotted
	BYTE	**NEC Technologies, Inc.**	**MultiSync XE17**	**$1060**	**▲▲▲▲**	**▲▲▲▲**	**▲▲▲▲**	**▲▲▲**	**▲▲▲▲**	**AS, AG**	**.28/dotted**
		Nokia Display Products, Inc.	Multigraph 447X	$1199	▲▲▲	▲▲▲▲	▲▲	▲▲	▲▲▲▲	AG, AS	.25/slotted
		Nokia Display Products, Inc.	Valugraph 447L	$695	▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	▲▲▲	AG, AS, AR	.25/dotted
		NSA Hitachi	Super 17s	$795	▲▲▲	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲	AG, AS, AR	.26/dotted
		NSA Hitachi	SuperScan Elite 17	$1049	▲▲▲	▲▲▲▲	▲▲▲	▲▲	▲▲▲	AG, AS, AR	.26/dotted
		Optiquest, Inc.	4500DC	$795	▲▲▲	▲▲▲	▲▲	▲▲	▲▲▲	AG	.28/dotted
		Orchestra Multisystems, Inc.	Tuba	$769	▲▲▲	▲▲▲	▲▲	▲▲▲▲	▲▲	E	.26/dotted
		Orchestra Multisystems, Inc.	Tuba-II	$795	▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲▲	NG	.26/dotted
		Panasonic Communications & Systems Co.	C1791E	$999	▲▲▲	▲▲▲▲	▲▲▲▲	▲	▲▲▲	AS, AG	.28/dotted
		Philips Consumer Electronics Co.	Brilliance 17A Model 1720DC	$1099	▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	▲▲▲▲	All apply	.27/dotted
		Qume	QM1791	$908	▲▲▲	▲▲▲	▲▲	▲	▲▲▲▲	NG	.26/dotted
		Radius	SuperMatch 17 XL	$1049	▲▲▲	▲▲▲▲	▲▲▲▲	▲▲	▲▲▲	All apply	.27/dotted
		Relisys	TF-1778L	$945	▲▲▲	▲▲▲	▲▲	▲▲	▲▲▲	NG	.26/dotted
		Samsung Electronics America	SyncMaster 17GL CST7687L	$849	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲	AS, NG	.28/dotted
		Samsung Electronics America	SyncMaster 17GLs CFA7689L	$949	▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	▲▲▲▲	AR	.26/dotted
		Samtron Displays, Inc.	SC-728SXL	$850	▲▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	▲▲▲	NG, AS	.28/dotted
		Sceptre Technologies, Inc.	Sceptre CC-617G	$695	▲▲▲	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲	All apply	.28/dotted
		Sceptre Technologies, Inc.	Sceptre CC-617GL+	$695	▲▲▲	▲▲▲	▲▲	▲▲	▲▲▲	All apply	.26/dotted
		Smile International, Inc.	CA1706M2	$785	▲▲▲	▲▲▲	▲▲	▲▲▲	▲▲▲	NG	.26/dotted
		Smile International, Inc.	CA1717M2	$695	▲▲▲	▲▲▲	▲▲	▲▲▲	▲▲	NG	.28/dotted
		Sony Electronics, Inc.	Multiscan 17se	$1250	▲▲▲	▲▲▲▲	▲	▲	▲▲▲	AG	.25/slotted
		Tatung Co. of America, Inc.	CM-17MKR	$945	▲▲▲	▲▲▲	▲▲	▲▲▲	▲▲▲	AG	.26/dotted
		TVM Professional Monitor Corp.	TVM AS 6A	$699	▲▲	▲▲▲	▲▲	▲▲	▲	NG, AS	.28/dotted
		ViewSonic	ViewSonic 17	$995	▲▲▲	▲▲▲▲	▲▲▲	▲	▲▲▲▲	AR, AG	.27/dotted
		ViewSonic	ViewSonic 17E	$795	▲▲▲	▲▲▲▲	▲▲▲	▲	▲▲▲	AG, AS	.28/dotted
		ViewSonic	ViewSonic 17G	$845	▲▲▲	▲▲▲▲	▲▲▲	▲	▲▲▲	AR, AG	.28/dotted
		Zenith Data Systems, Inc.	Z-Vision ZCM-1740-UT	$999	▲▲▲	▲▲▲▲	▲▲	▲▲	▲▲▲▲	AG	.26/slotted
20-INCH		Sony Electronics, Inc.	Multiscan 20se	$2450	▲▲▲	▲▲▲▲	▲	▲▲▲	▲▲▲	AG	.30/slotted
		Tatung Co. of America, Inc.	CM-20MKR	$1695	▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	▲▲▲	AG	.31/dotted
		TVM Professional Monitor Corp.	TVM AS 7G	$1199	▲▲▲	▲▲▲▲	▲▲	▲▲▲▲	▲▲▲	NG, AS	.31/dotted
21-INCH		Hitachi America, Ltd.	Accuvue GX-21	$2099	▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲	AR	.28/dotted
		IBM PC Co.	IBM 21P	$2600	▲▲▲	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲	AS, AR	.31/aperture g
		Idek/Iiyama North America	VisionMaster MF-8221	$1945	▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲▲	AG, AS, AR	.28/dotted
		Idek/Iiyama North America	VisionMaster MF-8621	$2495	▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲▲	AG, AS, BP	.26/dotted
		Idek/Iiyama North America	VisionMaster Pro MT-9121	$2150	▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲▲	AG, AS, BP	.30/slotted
		MAG InnoVision, Inc.	MX21F	$2199	▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲	NG, AS	.28/dotted
		Mitsubishi Electronics America, Inc.	Diamond Pro 21T	$2399	▲▲▲	▲▲▲▲	▲▲▲	▲▲	▲▲▲	AS, AR, AG	.31/slotted
	BYTE	**Nanao USA Corp.**	**FlexScan F760i-W**	**$2069**	**▲▲▲▲**	**▲▲▲▲**	**▲▲▲**	**▲▲▲▲**	**▲▲▲▲**	**AR, AS**	**.28/dotted**
		Nokia Display Products, Inc.	Multigraph 445X	$2250	▲▲▲▲	▲▲▲▲	▲▲	▲▲▲	▲▲▲▲	AG	.25/dotted
		NSA Hitachi	SuperScan Elite 21	$1995	▲▲▲▲	▲▲▲▲	▲▲▲	▲▲▲▲	▲▲▲	AG, AS, AR	.28/dotted
		NSA Hitachi	SuperScan Supreme 21	$2745	▲▲▲	▲▲▲▲	▲▲▲	▲▲	▲▲▲	AG, AS, AR	.26/dotted
		Philips Consumer Electronics Co.	Brilliance 21A Model 2130DC	$2999	▲▲▲▲	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲▲	AR, AS	.28/dotted
		Radius	SuperMatch 21*T XL	$2599	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲	▲▲▲	AG, AS, AR	.31/slotted
		RasterOps Corp.	ClearVueColor 21	$2499	▲▲▲	▲▲▲▲	▲▲	▲▲	▲▲▲▲	All apply	.25/dotted
		ViewSonic	ViewSonic 21	$1995	▲▲▲▲	▲▲▲▲	▲▲▲	▲▲	▲▲▲▲	AR, AG	.25/dotted

BYTE = BYTE Best. Key: Excellent ▲▲▲▲ Good ▲▲▲ Fair ▲▲ Poor ▲

Screen surfaces: AG = antiglare AR = antireflective AS = antista
BP = bonded panel E = etched NG = nonglar

COLOR MONITORS

FEATURES CONTINUE ON NEXT PAGE

MAX. DISPLAY WIDTH×HEIGHT (MM)	MAX. HORIZONTAL× VERTICAL RESOLUTION NI (PIXELS)	MISCONVERGENCE (MM)		PICTURE-TUBE MANUFACTURER	MIN./MAX. HORIZONTAL SCANNING FREQUENCY (KHZ)	MIN./MAX. VERTICAL SCANNING FREQUENCY (HZ)	INPUT CONNECTOR (15-PIN/BNC)	VIDEO BANDWIDTH (MHZ)
		CENTER	SIDES					
320×240	1280×1024	< .30	< .50	Toshiba	30/64	50/100	Yes/No	85
320×240	1280×1024	< .30	< .50	Hitachi	30/64	50/100	Yes/No	85
300×225	1600×1200	.20	.20	Hitachi	24/82	47/105	No/Yes	120
325×245	1280×1024	.30	.40	Matsushita	30/65	50/100	Yes/Yes	110
325×225	1600×1280	.30	.40	Hitachi	30/85	50/100	Yes/Yes	135
300×225	1280×1024	INP	INP	Toshiba	30/64	50/90	Yes/No	110
329×245	1280×1024	< .20	< .30	Hitachi	30/65	50/100	Yes/No	75
329×245	1280×1024	< .20	< .30	Hitachi	30/65	50/120	Yes/No	75
329.5×248.2	1280×1024	.40	.55	Hitachi	30/65.8	50/120	Yes/No	112
315×235	1600×1200	.15	.40	Sony	31/82	50/110	Yes/Yes	139
320×240	1600×1200	.30	.50	Hitachi	23.5/86	50/120	Yes/Yes	135
328×248	1280×1024	.20	.30	Hitachi	30/64	50/100	Yes/No	100
328.6×249.1	1600×1280	.20	.30	Toshiba	30/82	50/120	Yes/Yes	130
300×225	1280×1024	INP	INP	Hitachi	30/64	50/100	Yes/No	106
320×240	1280×1024	.35	.45	Mitsubishi	30/78	50/130	Yes/Yes	110
318×238	1280×1024	.30	.45	Toshiba	30/82	55/90	Yes/Yes	120
328×242	1600×1200	.30	.40	Sony	30/85	55/160	Yes/Yes	130
316×237	**1024×768**	**<.20**	**<.35**	**NEC**	**31/65**	**55/120**	**Yes/No**	**85**
315×236	1600×1200	<.30	<.40	Sony	30/82	50/110	Yes/Yes	140
327×246	1280×1024	.30	.40	Hitachi	31/64	48/100	Yes/No	100
316×237	1280×1024	.35	.45	Hitachi	30/64	50/100	Yes/No	125
325×245	1600×1280	.35	.45	Hitachi	30/82	55/120	Yes/Yes	135
316×236	1600×1280	.30	.40	Hitachi	30/82	50/100	Yes/No	135
330×241	1600×1200	.30	.40	Hitachi	30/78	50/90	Yes/Yes	110
330×241	1600×1200	.30	.40	Hitachi	30/82	50/90	Yes/Yes	135
300×225	1024×768	.15	.35	Matsushita	30/64	50/160	Yes/No	86
329×248	1600×1280	.30	.40	Matsushita	30/82	50/120	Yes/Yes	135
300×220	1600×1280	.30	.40	Hitachi	29/64	47/120	Yes/No	135
225×300	1024×768	.30	.40	Matsushita	31/64	50/90	Yes/Yes	100
310×235	1600×1280	.30	.50	Hitachi	30/82	50/120	Yes/Yes	130
320×240	1280×1024	.30	.40	Hitachi	30/64	50/100	Yes/No	106
320×240	1600×1200	.30	.40	Hitachi	30/82	50/120	Yes/Yes	135
320×240	1280×1024	.30	.40	Hitachi	30/65	50/100	Yes/No	110
328×245	1280×1024	< .30	< .50	Hitachi	30/66	50/90	No/No	110
328×245	1280×1024	< .30	< .50	Hitachi	30/66	50/90	Yes/No	110
325×245	1600×1280	.30	.40	Hitachi	30/80	50/90	No/Yes	100
325×245	1280×1024	.30	.40	Hitachi	30/65	50/90	No/No	80
300×225	1600×1200	.30	.40	Sony	31.5/82	50/150	No/Yes	100
290×218	1600×1280	.35	.50	Hitachi	28/82	50/120	Yes/Yes	130
290×218	1280×1024	.40	.50	Hitachi	29/66	50/90	Yes/Yes	100
316×237	1600×1280	.30	.40	Matsushita	30/82	50/160	Yes/Yes	135
305×231	1280×1024	.30	.40	Mitsubishi	30/64	50/90	Yes/No	86
320×240	1280×1024	.30	.40	Mitsubishi	30/64	50/160	Yes/No	86
321×236.5	1280×1024	.30	.40	Sony	30/82	50/110	Yes/No	140
373×280	1600×1200	.30	.40	Sony	31.5/85	50/150	No/Yes	100
350×262	1600×1280	.40	.55	Hitachi	28/82	50/120	Yes/Yes	130
360×270	1600×1280	.40	.60	Hitachi	28/82	50/120	Yes/Yes	130
15×310	1600×1280	.30	.45	Hitachi	28/90	50/152	Yes/Yes	130
395×292	1600×1200	INP	INP	Mitsubishi	31/82	30/82	Yes/Yes	139
06×304	1600×1280	.30	.40	Hitachi	25/85	50/120	Yes/Yes	135
06×304	1600×1280	.30	.40	Hitachi	25/85	50/120	Yes/Yes	135
397×297	1600×1280	.30	.40	Mitsubishi	24.8/92	50/160	Yes/Yes	200
07×304	1600×1280	.20	.30	Hitachi	30/82	50/120	Yes/Yes	135
08×306	1280×1024	.30	.40	Mitsubishi	30/85	50/125	Yes/Yes	150
03×298	**1280×1024**	**.35**	**.45**	**Hitachi**	**30/78**	**55/90**	**Yes/Yes**	**120**
00×300	1600×1200	.30	.40	Matsushita	30/102	50/120	No/Yes	200
06×302	1600×1280	.30	.40	Hitachi	30/94	50/150	Yes/Yes	160
06×302	1600×1280	.30	.40	Hitachi	31.5/107	50/150	No/No	200
06×304	1600×1280	.15	.20	Hitachi	30/82	50/160	Yes/Yes	150
380×285	1600×1280	.20/.30	.40	Mitsubishi	30/85.3	50/152	Yes/No	150
55×284	1600×1280	.40	.45	Matsushita	30/82	50/90	Yes/Yes	135
02×301	1600×1280	.30	.40	Matsushita	30/82	50/152	Yes/Yes	150

NI = noninterlaced. INP = information not provided.

ROLL CALL OF LARGE-SCREEN

MANUFACTURER	MODEL	DISPLAY MODES (NUMBER OF PRESET/USER-DEFINED)	NI VERTICAL REFRESH RATE (HZ)						
			VGA 640×480	MAC 16-INCH 832×624	SUPERVGA 800×600	1024×768	MAC 1152×870	1280×1024	1600×1280
17-INCH									
ADI Systems, Inc.	MicroScan 5AP	10/8	60	N/A	72	70	N/A	60	101[1]
ADI Systems, Inc.	MicroScan 5EP	10/8	60	N/A	72	70	N/A	60	101[1]
Amdek	AM/817E	14/6	72	N/A	72	76	72	76	60
CTX International, Inc.	1765GM	15/10	75	75	75	75	N/A	60	N/A
CTX International, Inc.	1785GM	15/15	75	75	75	75	75	75	60
Dyna Micro, Inc.	MON-172GLR	16/16	72	N/A	72	70	N/A	60	N/A
ETC Computer, Inc.	ViewMagic CA-1765CPL	13/17	72	75	72	70	N/A	60	N/A
ETC Computer, Inc.	ViewMagic CA-1765SPL	13/17	72	75	72	70	N/A	60	N/A
Goldstar U.S.A., Inc.	1725	7/8	75	75	Varies	76	Varies	60	N/A
IBM PC Co.	IBM 17P	14/16	72	77	72	75	75	77	60
Idek/Iiyama North America	VisionMaster MF-8617	6/21	73	75	75	70	75	80	66
MAG InnoVision, Inc.	DX17F	16/8	100	75	90	76	N/A	60	N/A
MAG InnoVision, Inc.	MXP17F	26/8	100	75	120	100	N/A	76	60
Megatron	MegaImage S17MGP	12/11	76	75	76	72	75	60[1]	N/A
Mitsubishi Electronics America, Inc.	Diamond Scan 17FS	6/4	60	75	75	70	75	75	N/A
Nanao USA Corp.	FlexScan F560i-W	9/19	60	75	72	70	75	72	60
Nanao USA Corp.	FlexScan T2-17	10/10	75	75	75	75	75	75	68
BYTE **NEC Technologies, Inc.**	**MultiSync XE17**	**14/20**	**Varies**	**75**	**Varies**	**Varies**	**N/A**	**87[1]**	**N/A**
Nokia Display Products, Inc.	Multigraph 447X	3/23	Varies	INP	INP	75	INP	INP	INP
Nokia Display Products, Inc.	Valugraph 447L	5/12	72	INP	75	75	INP	INP	INP
NSA Hitachi	Super 17s	7/11	100	100[1]	100	80	76	60	N/A
NSA Hitachi	SuperScan Elite 17	7/24	120	120[1]	120	100	90	76	66
Optiquest, Inc.	4500DC	9/6	72	75	72	75	75	72	60
Orchestra Multisystems, Inc.	Tuba	17/32	72	N/A	72	75	N/A	72	60
Orchestra Multisystems, Inc.	Tuba-II	17/32	72	N/A	72	75	N/A	72	60
Panasonic Communications & Systems Co.	C1791E	17/17	72	75	72	72	75	60	N/A
Philips Consumer Electronics Co.	Brilliance 17A Model 1720DC	12/15	60	75	72	70	75	76	60
Qume	QM1791	14/6	72.8	N/A	56.2	70	N/A	72	76
Radius	SuperMatch 17 XL	13/16	Varies	75	Varies	75	N/A	60	N/A
Relisys	TF-1778L	11/19	60	75	56	Varies	75	Varies	65
Samsung Electronics America	SyncMaster 17GL CST7687L	12/11	60	74.5	Varies	Varies	N/A	60	N/A
Samsung Electronics America	SyncMaster 17GLs CFA7689L	12/11	59.9	74.5	Varies	Varies	75	Varies	60
Samtron Displays, Inc.	SC-728SXL	14/10	60	75	75	75	N/A	60	N/A
Sceptre Technologies, Inc.	Sceptre CC-617G	11/20	Varies	75[1]	75	75	75	60	N/A
Sceptre Technologies, Inc.	Sceptre CC-617GL+	11/20	Varies	75[1]	75	75	75	60	N/A
Smile International, Inc.	CA1706M2	10/30	70	75	56	75	75	70	60
Smile International, Inc.	CA1717M2	10/30	70	75	56	70	N/A	60	87[1]
Sony Electronics, Inc.	Multiscan 17se	9/11	60	75	72	Varies	75	Varies	60
Tatung Co. of America, Inc.	CM-17MKR	25/25	60	75	Varies	Varies	75	Varies	60
TVM Professional Monitor Corp.	TVM AS 6A	10/17	72	N/A	72	72	76	60	N/A
ViewSonic	ViewSonic 17	8/8	152	75	120	100	75	76	66
ViewSonic	ViewSonic 17E	13/13	90	75	90	76	N/A	60	N/A
ViewSonic	ViewSonic 17G	3/8	120	75	90	76	N/A	60	N/A
Zenith Data Systems, Inc.	Z-Vision ZCM-1740-UT	9/20	72	N/A	85	76	N/A	75	N/A
20-INCH									
Sony Electronics, Inc.	Multiscan 20se	9/11	60	75	75	Varies	75	Varies	60
Tatung Co. of America, Inc.	CM-20MKR	25/25	60	75	Varies	Varies	75	Varies	60
TVM Professional Monitor Corp.	TVM AS 7G	10/17	75	N/A	75	76	76	76	60
21-INCH									
Hitachi America, Ltd.	Accuvue GX-21	4/16	60	132	75	109	75	84	72
IBM PC Co.	IBM 21P	12/10	75	60	77	70	88	77	60
Idek/Iiyama North America	VisionMaster MF-8221	9/34	73	75	72	75	75	80	66
Idek/Iiyama North America	VisionMaster MF-8621	9/34	73	75	72	75	75	80	66
Idek/Iiyama North America	VisionMaster Pro MT-9121	13/32	73	75	72	75	75	80	72
MAG InnoVision, Inc.	MX21F	26/8	100	75	90	100	75	76	60
Mitsubishi Electronics America, Inc.	Diamond Pro 21T	12/10	60	75	75	Varies	75	78	66
BYTE **Nanao USA Corp.**	**FlexScan F760i-W**	**9/19**	**60**	**75**	**72**	**70**	**75**	**72**	**60**
Nokia Display Products, Inc.	Multigraph 445X	14/14	60	INP	INP	75	75	70	63.7
NSA Hitachi	SuperScan Elite 21	8/23	150	140[1]	140[1]	115	100	85	75
NSA Hitachi	SuperScan Supreme 21	8/23	150	N/A	N/A	Varies	115	100	85
Philips Consumer Electronics Co.	Brilliance 21A Model 2130DC	12/7	60	75	75	75	75	76	60
Radius	SuperMatch 21"T XL	9/6	60	74.5	Varies[1]	70	75	Varies	68.66
RasterOps Corp.	ClearVueColor 21	13/8	Varies	75	72	75	75	Varies	65
ViewSonic	ViewSonic 21	13/8	152	75	120	100	75	76	66

BYTE = BYTE Best.   ✓ = yes.   N/A = not applicable.   [1] interlaced.   NI = noninterlaced.   INP = information not provided.

COLOR MONITORS

CONTROLS														
HORIZONTAL PHASE	FOCUS	CONVERGENCE	SIGNAL LEVEL	PINCUSHIONING	ON-SCREEN MENUS	COLOR MATCHING	INTERNAL POWER MANAGEMENT SYSTEM	NET WEIGHT (LBS.)	DIMENSIONS (HEIGHT× WIDTH×DEPTH IN INCHES)	FCC CLASS	WARRANTY (YEARS)	PHONE NUMBER	TOLL-FREE PHONE	INQUIRY NUMBER
✓				✓		✓	✓	48	17.5×16.1×15.2	B	2	(408) 944-0100	(800) 228-0530	1105
✓				✓		✓	✓	48	17.5×16.1×15.2	B	2	(408) 944-0100	(800) 228-0530	1106
✓				✓				55	16.2×14.7×15.4	A	1	(408) 473-1200	(800) 722-6335	1107
				✓		✓	✓	75	17.0×16.4×18.4	B	2	(909) 595-6146	(800) 888-2017	1108
				✓		✓	✓	55	16.4×17.2×18.4	B	2	(909) 595-6146	(800) 888-2017	1109
				✓			✓	41	15.0×16.0×16.0	B	2	(408) 943-0100	(800) 362-3962	1110
✓				✓		✓	✓	39	15.9×16.5×17.3	B	2	(510) 226-6250	N/A	1111
✓				✓	✓	✓	✓	39	15.9×16.5×17.3	B	2	(510) 226-6250	N/A	1112
				✓				41.8	17.1×16.5×18.9	B	2	(201) 816-2000	N/A	1113
		✓		✓	✓	✓	✓	26	17.7×16.1×17.9	B	3	N/A	(800) 772-2227	1114
				✓		✓	✓	47	16.7×16.2×18.3	B	3	(215) 957-6543	(800) 394-4335	1115
✓				✓			✓	50.6	16.9×16.0×17.1	B	3	(714) 751-2008	(800) 827-3998	1116
✓				✓	✓	✓	✓	50	17.3×17.3×18.8	A	3	(714) 751-2008	(800) 827-3998	1117
		✓		✓	✓		✓	46	11.1×10.7×10.9	B	1	(714) 777-6166	N/A	1118
✓				✓	✓	✓		47.5	16.0×16.1×17.3	B	3	(714) 236-6352	(800) 843-2515	1119
✓	✓	✓		✓		✓	✓	49.7	16.3×16.2×17.6	B	3	(310) 325-5202	(800) 800-5202	1120
		✓		✓	✓	✓	✓	55	16.4×16.2×18.5	B	3	(310) 325-5202	(800) 800-5202	1121
✓	✓	✓	✓	✓	✓	✓	✓	48	17.1×16.4×19.2	B	3	(708) 860-9500	(800) 632-4636	1122
✓	✓	✓	✓	✓	✓	✓	✓	44	16.2×16.9×18.4	B	3	(415) 331-6622	(800) 296-6542	1123
				✓			✓	41	16.9×16.8×19.0	B	3	(415) 331-6622	(800) 296-6542	1124
			✓	✓		✓	✓	45	16.6×15.9×17.2	B	3	(617) 461-8300	(800) 441-4832	1125
			✓			✓	✓	49	16.9×16.1×18.3	B	3	(617) 461-8300	(800) 441-4832	1126
				✓		✓	✓	48.9	16.3×16.2×16.9	B	1	(909) 468-3750	(800) 843-6784	1127
✓								50	16.1×17.3×16.9	B	2	(714) 891-3861	(800) 237-9988	1128
✓	✓	✓	✓	✓	✓	✓		50	16.1×17.3×16.9	B	2	(714) 891-3861	(800) 237-9988	1129
			✓	✓	✓	✓	✓	38.5	16.6×16.1×17.3	B	1	(201) 348-7000	(800) 742-8086	1130
✓				✓			✓	46	16.5×16.5×17	B	3	(310) 217-1300	(800) 835-3506	1346
✓		✓	✓	✓	✓	✓	✓	42.2	17.1×16.5×16.5	B	1	(408) 473-1530	(800) 457-4447	1347
✓				✓			✓	44	16.0×16.3×16.8	B	1	(408) 434-1011	N/A	1348
✓			✓	✓		✓	✓	42	16.6×16.5×16.7	A	2	(408) 945-9000	(800) 783-2333	1349
				✓	✓			46.2	17.1×16.6×17.0	B	2	(201) 229-4000	(800) 726-7864	1350
				✓	✓	✓		46.2	17.1×16.6×17.0	B	2	(201) 229-4000	(800) 726-7864	1351
✓				✓	✓		✓	50	16.0×16.0×17.0	B	3/2	(310) 638-1282	N/A	1352
✓				✓			✓	41	15.5×15.5×17.5	B	3	(818) 369-3698	(800) 788-2878	1353
✓				✓			✓	41	15.5×15.5×17.5	B	3	(818) 369-3698	(800) 788-2878	1354
✓				✓			✓	44	16.2×16.5×16.5	B	2	(714) 546-0336	(800) 876-4532	1355
✓				✓			✓	42	16.2×16.5×16.5	B	2	(714) 546-0336	(800) 876-4532	1356
		✓		✓		✓	✓	49.6	16.3×15.9×17.7	B	3	(408) 432-0190	(800) 352-7669	1357
✓				✓			✓	50	15.0×16.2×18.9	A	1	(310) 637-2105	(800) 829-2850	1358
			✓	✓				47	17.1×16.4×19.2	A	2	(909) 988-3368	(800) 822-8168	1359
			✓	✓	✓	✓	✓	39.5	16.6×16.1×17.2	B	3	(909) 869-7976	(800) 888-8583	1360
			✓	✓		✓	✓	40.1	16.5×16.3×17.4	B	3	(909) 869-7976	(800) 888-8583	1361
			✓	✓	✓	✓	✓	38	16.6×16.1×17.2	B	3	(909) 869-7976	(800) 888-8583	1362
✓	✓	✓		✓			✓	51	16.7×16.8×18.1	B	1	(708) 808-5000	(800) 582-0524	1363
		✓		✓		✓	✓	66.1	18.7×18.7×19.7	B	3	(408) 432-0190	(800) 352-7669	1364
✓				✓			✓	61	18.9×18.9×21.3	A	1	(310) 637-2105	(800) 829-2850	1365
			✓	✓			✓	63	18.7×19.2×21.6	A	2	(909) 988-3368	(800) 822-8168	1366
				✓		✓	✓	75	18.5×19.7×20.1	B	1	(201) 573-0774	(800) 225-1370	1367
		✓		✓	✓	✓	✓	84	19.7×19.5×21.5	A	3	N/A	(800) 772-2227	1368
			✓	✓		✓	✓	73	18.5×19.3×21.1	A	3	(215) 957-6543	(800) 394-4335	1369
			✓	✓		✓	✓	73	18.5×19.3×21.1	A	3	(215) 957-6543	(800) 394-4335	1370
		✓	✓	✓	✓	✓	✓	80	20.3×19.6×20.4	A	3	(215) 957-6543	(800) 394-4335	1371
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✓		✓		✓		✓		79.5	19.4×19.4×21.4	A	3	(714) 236-6352	(800) 843-2515	1373
	✓	✓		✓		✓	✓	77.2	19.2×19.7×21.1	B	3	(310) 325-5202	(800) 800-5202	1374
✓	✓	✓	✓	✓	✓	✓	✓	71	20.5×20.2×19.7	B	3	(415) 331-6622	(800) 296-6542	1375
			✓	✓		✓	✓	73	18.7×19.2×21.0	A	3	(617) 461-8300	(800) 441-4832	1376
				✓	✓	✓	✓	73	18.7×19.2×21.0	A	3	(617) 461-8300	(800) 441-4832	1377
✓	✓	✓	✓	✓	✓	✓	✓	82	19.0×20.0×21.0	A	3	(310) 217-1300	(800) 835-3506	1378
✓		✓		✓		✓	✓	81	19.4×19.4×21.4	B	1	(408) 434-1011	N/A	1379
✓			✓	✓		✓	✓	66	18.8×19.9×20.1	B	1	(317) 577-8788	(800) 729-2656	1380
			✓	✓		✓	✓	65	18.9×19.9×20.1	B	3	(909) 869-7976	(800) 888-8583	1381

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FPU Precision

Ndiff, a custom comparison program, helps programmers sort out how various hardware platforms calculate FPU operations differently

OLIVER SHARP

Programmers who work with floating-point-intensive applications know that obtaining accurate numbers can be tricky. One particularly awkward problem is that floating-point applications do not produce identical results on different machines. In fact, the results can even change when switching from one compiler to another.

Traditionally, programmers have used a utility such as diff to compare two text files to see if two versions of a code are in agreement. But diff may not be sufficient for FPU-intensive applications. Two programs may both be working correctly even though every number they compute is different. Considering that scientific applications may produce thousands or millions of numbers as results, how can a programmer check whether the code is executing properly on different machines? To address this problem, I wrote a program I call ndiff.

Different Results

To understand how an application can behave differently on different hardware platforms, we need to look at the way computers handle non-integer values.

A floating-point value consists of a sign, an exponent, and a significand. In the IEEE standard, a single-precision floating-point value equals (–1)^S * (1+significand) * 2^(exponent–127). Some real numbers can be expressed precisely, but most do not have an exact representation. The listing "Demonstrating Floating-point Round-off" computes the square root of 2, squares that, and compares the final result to 2. On a SPARC workstation, the difference is 1.2e–7; on a Cray C90, it is 1.4e–14.

Programmers commonly do two things that affect the results of a floating-point application: They change the precision of the code and the order in which operations are executed.

In the first case, *precision* simply refers to the number of bits that are used to store floating-point values. Modern computers typically offer two sizes: 32 bits, known as single precision, and 64 bits, known as double precision. Although these sizes are specified by the IEEE/ANSI standard and have become widely accepted, they are not universal and are certain to change in the future as the length of the machine instruction word continues to increase. A given program won't always run on a machine with the same word size as the one on which it was originally written. Moving to an architecture with a different representation size will almost always change the results of floating-point programs.

One of the reasons that "Demonstrating Floating-point Round-off" behaves differently on the SPARC and Cray computers is that the latter uses 64 bits for single precision. Changing precision alters the rounding behavior and usually changes the results. (Language mechanisms are another way to change precision.)

A second source of trouble relates to something most of us learned in grammar school. We were taught that arithmetic operations like multiplication and addition are commutative (i.e., A x B and B x A yield the same result) and associative ([A+B]+C is the same as A+[B+C]). However, neither is true in computer addition.

Unfortunately, a compiler must often rearrange the order of computations to improve program performance. "Reordering for Optimization" shows a simple example using a standard compiler optimization called loop-invariant code motion. This transformation moves computations that are inside a loop but don't need to be. In the example, the new code computes B+C once instead of redoing it 100 times. However, if addition is performed left to right in this language, the original code computed (result+B)+C. The new version uses result+(B+C) instead, which is not necessarily the same thing.

While changing the order is often a significant improvement on single-processor machines, the benefit can be much more dramatic on a parallel architecture. For example, suppose that we have an array of one million elements and wish to compute the sum. At first glance, this seems to be the perfect problem to solve on a parallel machine. If there are 100 processors, we can use each one to add 10,000 of the elements together. Then we do a final pass, adding the partial sums, and the computation will be just under 100 times as fast (depending on communication requirements and how that final pass is implemented).

Demonstrating Floating-point Round-off

```
/*  sqrt.c - the problems of approximation  */

#include <stdio.h>
#include <math.h>

main()
{
  float a;

  a = sqrt(2.0);
  a = a*a;
  if (a == 2.0)
    printf("a is 2\n");
  else
    printf("a isn't 2; the difference is %e\n",a-2.0);
}
```

However, the new and efficient parallel algorithm adds the numbers differently than the original did. Instead of going from one end of the array to the other, the pieces of the array that are allocated to each processor are summed first. Because addition is not associative, the modification of the order will change the final results. Such changes often make it difficult to know when a parallel program is debugged. Even when the program is working correctly, all of its results are slightly different than the ones from the sequential version. Although such changes are often unavoidable, ndiff can help to determine how large the differences are.

Reordering for Optimization

```
original code:                                optimized code:

for i = 1, 100                               bplusc = B+C:
  result = result+B+C:                        for i = 1, 100
                                                result = result+bplusc
```

The Program

Ndiff works by going through two files in lockstep to compare each line. It scans each pair of lines twice. The first pass looks at everything but numbers to verify that the letters and symbols in the two lines are identical. If there are any differences, ndiff prints out the two lines together, with a line-number prefix. Because the idea behind ndiff is to compare the output of the same program on different architectures, there will generally be few or no differences that aren't numerical. However, the program might do something like print out the current date and time, so ndiff can't simply give up when the files don't match.

If the lines are identical aside from their numerical values, ndiff rescans them looking for pairs of numbers. It reads in the numbers as double-precision floating-point values and compares them. Note that ndiff depends on the library routine `sscanf()` to parse the numbers; a poorly written implementation of that routine will affect the results that ndiff generates.

Once you load a pair of numbers, ndiff compares them. If they are identical, ndiff discards them and continues. If not, it computes a number of statistics that describe the way they differ, including the absolute value of the difference and the percentage. Once ndiff completes its work, it prints out a report describing the relationship of the two files.

"An Ndiff Report" shows two sample input files and ndiff's analysis of them. Running diff on the files would only reveal that the first lines are identical. Ndiff is more helpful because it provides a statistical summary of the differences to help reveal whether they are the results of architectural and compiler effects.

Ndiff uses a variety of statistics, because any single one can be misleading. One strategy for comparing numbers is to consider only the magnitude of the difference and require that it be small. For example, 1 and 1.000001 only differ by 10^{-6} and are probably close enough for practical purposes. But absolute magnitudes can't be interpreted without some information about the application that generated them. If the program is computing the distance between two galaxies in meters, a difference of a few thousand is probably negligible. When computing the number of microns between atoms, however, a difference of one would be unacceptable. Therefore, ndiff computes both the magnitude of the difference and the percentage difference. If the difference is a tiny percentage, it can probably be ignored.

After comparing the two files, ndiff reports the largest percentage and the largest difference it encountered for any number pair. In general, if the maximum percentage is small, the two files are essentially identical, and you can ignore the rest of the report.

Even if the maximum percentage is large, all may still be well, but the programmer must be careful, because large maximums can conceal problems. In "An Ndiff Report," some of the numbers differed by a large percentage and some by a large magnitude. The first half of the report suggests that the files are almost identical, but it could be deceptive. Suppose that the files contained the corresponding pair (500,1000)—a pairing that should certainly be a major cause for concern. That pair wouldn't change the maximums, though, because ndiff already finds a larger difference and a larger percentage in the file as it is now.

The second half of ndiff's report reveals these hidden pairings. It is a set of threshold rules computed for several different percentages. A threshold rule consists of two values, P and M, and means that every pair of corresponding numbers in the files is either within P percent of one another or has a difference less than M. In the "Thresholds" portion of "An ndiff Report," the third line reveals that differences larger than 1.0 percent are all small (less than .01). The pair (500,1000) would completely change the threshold rules: for both 1 percent and 10 percent, M would be 500. The programmer can quickly tell from the thresholds when a potentially troublesome pairing is concealed by the maximum values.

An Ndiff Report

```
file1:
**
This file contains several numbers for ndiff to work on.

0.02 1026060.33 343.8599 4444444.33454 1000
**

file2:
**
This file contains several numbers for ndiff to work on.

0.01 1033409.11 343.8667 4444493.22983 1000
**

output:

**
4 numbers differ between the two files out of 5 comparisons.
 Average of the differences: 1.849423e+03
 Largest difference:          7.348780e+03 on line 3 (was 0.711%)
 Average percent difference: 12.500%
 Largest percent difference: 50.000% on line 3 (was 1.000000e-02)

Thresholds:
   Differences were either below          or less than
                         0.001%              7.348780e+03
                         0.010%              7.348780e+03
                         0.100%              7.348780e+03
                         1.000%              1.000000e-02
                        10.000%              1.000000e-02
```

Scientific Tool

Ndiff is not a perfect solution to the problem of variation in floating-point behavior, but it is a useful tool for programmers who must work on the same code in different environments. I've relied on it often when working with and parallelizing scientific applications using a diversity of architectures and compilers. Ndiff is available electronically. For information about downloading the program, see "Program Listings" on page 5. ■

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AMD's 29030 Microprocessor

Based on the proven 29K RISC core, this processor is ideal for embedded applications

FLOYD GOODRICH

You can find Advanced Micro Devices' family of 29000 RISC microprocessors and integrated RISC microcontrollers throughout several large segments of the office automation market. They are used in printers (both color and black-and-white) and function as both the printers' controllers and rasterizers. In telecommunications work, they act as central office switches. They can be found in networks, controlling routers and hubs and managing RAID arrays for storage applications. The high performance of these 29000 RISC processors, especially their ability to manipulate and transfer data at high speeds, makes them an ideal fit in these markets.

These 29000 processors, better known as the 29K family, comprise three product lines. First are the general-purpose RISC processors, which use a modified Harvard architecture and have separate buses for instruction and data accesses. Next is a series of microprocessors that have on-chip caches and thus require only a single bus for instruction and data fetches. The final group is a series of integrated RISC microcontrollers. Before I delve into the details of a specific processor, I'll provide a basic description of the 29K microarchitecture. Later, I'll use that information to expand on the feature set of the AMD 29030, a RISC microprocessor tailored for demanding embedded applications.

29K Roots

All 29K family members use the same 32-bit core microarchitecture and compatible object code. The microarchitecture's instruction set consists of fixed-length 32-bit instructions. The 29K core supports many standard RISC features, such as pipelining, load overlapping and forwarding, and architectural parallelism. But the 29K core also includes several unique high-performance features, such as a large register file and fast interrupt handling.

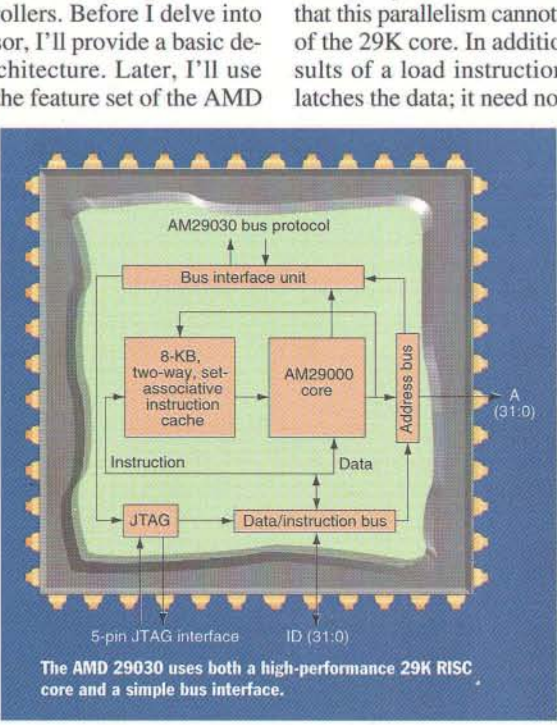
Among the 29K microarchitecture's standard RISC features is a four-stage (fetch, decode, execute, and write back) pipeline that can process, on average, an instruction every 1.26 clock cycles for typical application code. Like all RISC processors, the 29K relies on a load/store architecture. This lets a compiler or a programmer minimize or eliminate pipeline stalls by scheduling memory accesses within the instruction stream.

An on-chip, four-instruction prefetch buffer decouples the pipeline execution speed from the memory speed. Most instruction accesses come from the instruction cache, but when the processor must fetch instructions from memory, the prefetch buffer minimizes delays. By sending the first instruction fetched from memory directly to the pipeline instead of waiting for all four instructions within a cache block to arrive, the prefetch buffer minimizes the latency associated with instruction-cache misses.

In addition, the 29K core has methods for allowing instructions to continue executing while memory accesses occur. Appropriately scheduling load and store operations is critical for high-performance operation, because over a quarter of all instructions involve memory accesses. To promote efficiency, the 29K core uses overlapping and forwarding techniques to eliminate pipeline stalls that would otherwise arise when the pipeline has to wait for data. With proper scheduling, the 29K core can typically maintain single-cycle execution through load instructions, provided the results of the load operation are not immediately required. Interlocks between pipeline stages ensure that this parallelism cannot result in the incorrect operation of the 29K core. In addition, the pipeline receives the results of a load instruction as soon as the bus interface latches the data; it need not wait for an entire buffer to fill before the critical instruction is sent to the pipeline.

Finally, the 29K core uses three-operand instructions: Its instructions use two registers as sources, and a third register serves as the destination of the operation. This differs from a two-operand instruction architecture, in which numerous register-to-register move instructions must be added to a RISC program simply to preserve one of the source operands.

Because the source operands are preserved, fewer instructions are required to combat data destruction, and 29K processor programs are more compact. Also, the three-operand instruction format



The AMD 29030 uses both a high-performance 29K RISC core and a simple bus interface.

closely matches compiler-generated data structures, making it a more natural fit for compiler-generated code.

Unique Core Details

The characteristics mentioned thus far are standard fare that all RISC processors use to improve throughput. But the 29K core has several unique features that boost performance. First, it has a huge register file. Other RISC processors might have a register file with 32 or 64 entries, but the 29K has a 192-entry register file. This enables a compiler to assign all of a procedure's local variables to registers, avoiding the penalty of using load/store operations to store these variables in RAM. To maximize performance, this register file is triple-ported, which allows it to supply two source operands and receive one destination operand at the same time and which makes access faster than it would be from an on-chip cache. In addition, the register file is available to an earlier pipeline stage (the decode stage) than a cache would be, which shaves the fetch stage from the pipeline. But the greatest benefit of the large register file is the elimination of save-and-restore code on procedure calls. Removing this type of code can improve procedure-call performance by as much as a factor of 10.

The 29K core does not save the state of a machine when an interrupt or exception occurs, which makes interrupt-handling routines extremely fast. A systems programmer can decide to write code to save the state of the machine or elect not to preserve the machine's state and offer fast interrupt service.

The Am29030

The Am29030 incorporates the 29K core, along with certain performance-enhancing features. The 29030 uses the 29K family's 32-bit architecture and is implemented in CMOS. It has clock speeds of 20, 25, and 33 MHz. The 29030 has an on-chip, 8-KB, two-way set-associative instruction cache; an integrated memory management unit; and scalable clocking that lets you get high performance using low-cost memory. These and other features make the 29030 attractive to the embedded-control market.

Traditionally, the embedded-control market has had a fixed set of requirements for success. First is object-code compatibility. The time-to-market requirements of embedded applications place incredible pressure on software engineers to create good, stable code in a minimum of time. Object-code compatibility thus ensures that a new project can reuse field-tested procedures drawn from a stable of reliable and well-understood program code.

Another key to success in the embedded market is restricting the use of peripheral interface hardware. Embedded control applications are generally cost-sensitive—so much so that the design should not demand that additional money be spent on components. A bus interface that is simple, yet it supports high-speed transfers is highly desirable for these applications.

The 29030 bus supports accesses to 8-, 16-, and 32-bit instruction memory and accesses to 16- or 32-bit data memory. This lets a system designer select the appropriate memory width, given the performance and cost constraints. For example, to achieve the highest performance, a designer might have the 29030 copy a program out of inexpensive 8-bit ROMs into 32-bit memory, then execute the program in RAM.

The 29030 supports burst transfers up to 1 KB in length. In these transfers, the processor can achieve single-cycle transfers of 32 bits, to or from memory. This high sustained transfer rate lets you fetch instructions quickly even when using inexpensive paged-mode DRAM, and it also supports fast software-controlled transfers of data to and from inexpensive bursting memory. Because data accesses can be big-endian or little-endian, the 29030 can be connected to a variety of peripherals. The 29030 uses three lines to support conventional and burst transfers. Interface complexity is further reduced by using two synchronous buses: an address bus of 32 lines and a data/instruction bus of 32 lines (see the figure). This reduces the board area required by the processor and the number of bus connections; it also lowers the parts count for the memory subsystem. Because the 29030 bus interface is straightforward, a hardware designer does not need to spend a great amount of money or time on system glue logic.

The scalable clock is an on-chip phased-locked loop that lets the 29030 processor run internally at full speed (say, 33 MHz) while the external bus runs at half speed (16.67 MHz). In this configuration, the processor, with its instruction cache, provides high performance but uses low-cost memory. As with other parts of the 29030, the designer of a system that uses less expensive memory may decide whether to use scalable clocking to contain costs or obtain maximum performance by using faster memory.

By squeezing high performance from inexpensive memory, the 29030 achieves an attractive system cost-to-performance ratio. It is important to note that the cost-to-performance ratio should be based on the cost of the entire system, not simply on the processor's cost. Processors cheaper than the 29030 are on the market, but they require more expensive system components and memory, which drives up the total cost of the system.

Another unique feature of the 29030 is traceable caching, which lets an emulator or any generic postprocessor reconstruct a real-time code trace that is visible in the cache. Typically, a system engineer must turn off a processor's on-chip cache to force visible transactions on the bus for debugging purposes. This is inadequate for quickly solving complex program interactions involving on-chip caches. The 29030 implements cache tracing by using a second 29030 on an ICE (in-circuit emulator) acting as a slave while the 29030 on the controller board acts as the master. The master processor executes the program and generates all bus transactions for both processors. The slave processor executes the same instructions but uses its address bus to drive all cached branch target addresses. This lets the ICE read these addresses and construct a trace of program flow inside the cache. To ensure prompt visibility of a cache and improve the debugging process, AMD expects to deploy this technology on all 29K products containing on-chip caches.

Future Directions

One further advantage of the 29030 is a simple upgrade path. You can move up to the next-generation microprocessor, the Am29040, without changing the design of a system. The 29040 adds an on-chip data cache and hardware integer multiplier, in addition to running at higher frequencies internally. Because the 29030 and the 29040 are object-code compatible, you can run the same software. The 29040 is also bus-compatible and footprint-compatible with the 29030. It can plug into the same socket as the 29030, and it interfaces to the same logic as the 29030 does. The 29040 provides a clean migration path while limiting development time and maintaining the attractive cost-to-performance ratio that embedded applications demand. ■

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The Oberon/F System

A lightweight, portable, object-oriented component framework

DICK POUNTAIN

Oberon/F is the latest addition to an important new software category, the object-oriented component framework. NextStep's AppKit is the most famous current exemplar; Taligent's TalAE will soon be contesting that title. Oberon/F provides a thin object-services layer that runs on top of the host operating system and lets you write cross-platform, portable, and extensible applications as if the host operating system supported full object orientation. Although currently in beta for Windows and Macintosh System 7, Oberon/F versions are also planned for OS/2 and Unix/Motif. The Oberon/F system is being developed by Niklaus Wirth's Oberon Microsystems (Zurich, Switzerland).

Component frameworks aim to reduce the huge learning curve of class libraries and to enable software reuse by supplying big and already-useful chunks. If using a class library is like buying a load of bricks, then using a framework is like erecting a prefabricated house, with the walls already assembled.

Oberon/F is a wholly document-centric framework in which everything is a document that you can edit within the development system, which also serves as the run-time system. Every Oberon/F document contains one or more views—software components that let you view and edit a particular data type, such as text, a graphic, or a spreadsheet. Each view is implemented by a separate module, which gets dynamically linked and loaded on demand like a DLL. Unlike with Windows DLLs or VBXes (Visual Basic custom controls), however, you can extend Oberon/F modules. If the appropriate module is present, any Oberon/F document editor can edit any type of view, so the concept of applications owning files completely dissolves.

Oberon/F incorporates a highly efficient but proprietary compound document model that lets you embed views into one another in arbitrarily complex ways. In future releases, this system will be progressively integrated with OLE and OpenDoc.

The Oberon/F Development Environment

Oberon/F is based on Oberon 2, language successor to Pascal and Modula 2, and includes a compiler and debugger for this language. Oberon 2 is a strongly typed, compiled language that supports both modular and object-oriented programming as well as Eiffel-like precondition and postcondition testing using ASSERT statements. It includes an automatic garbage collector to preserve memory integrity, an unusual feature for a compiled language. The driving force throughout the Oberon/F project has been the pursuit of simplicity. The beta-0.9 Oberon/F system arrived on a single 1.44-MB floppy disk and occupies barely 4 MB of hard disk space.

The programming, editing, and debugging environment is completely integrated, giving it the same feel as interactive interpreted systems like SmallTalk or Lisp. This is an illusion, as Oberon 2 compiles straight to 32-bit native 486 or 680x0 code. However, the compiler is so fast at 15,000 lines per minute, and the modules you write are typically so small, that compilation time is seldom noticeable.

The compiler, debugger, and other software tools are all based on Oberon/F compound documents. In a Show Loaded Modules window, for example, you can highlight any module name in the list and immediately decompile its interface definition; in a debug window, clicking on diamond-shaped markers lets you follow pointers and traverse lists; in the editor, errors are flagged by markers embedded in the text, which expand into error messages when you click on them.

continued

Extending the Oberon/F Texts Component

```
MODULE DickText;
IMPORT TextModels, TextControllers;
  PROCEDURE UpCase*;
  VAR beg, end: LONGINT;
          ch: CHAR;
           c: TextControllers.Controller;
         buf: TextModels.Model;
           r: TextModels.Reader;
           w: TextModels.Writer;
  BEGIN
    (* determine extent of selected text *)
    c := TextControllers.Focus();
    IF (c # NIL) & c.HasSelection() THEN
      c.GetSelection(beg,end);
      (* make a buffer for uppercase text *)
      buf := TextModels.dir.New(); (* a directory object *)
      w := buf.NewWriter(NIL);
      r := c.text.NewReader(NIL);
      r.SetPos(beg);
      (* process selected text into buffer *)
      r.ReadChar(ch);
      WHILE (r.Pos() <= end) & ~r.eot DO
        IF (ch >= “a”) & (ch <= “z”)
        THEN ch := CAP(ch) END;
        w.WriteChar(ch);
        r.ReadChar(ch)
      END;
      (* copy buffer back into document *)
      c.text.Delete(beg,end);
      c.text.CopyFrom(beg,buf,0,end-beg);
    END
  END UpCase;
END DickText.
```

The Texts Subsystem

The first release of Oberon/F provides just two component subsystems called *Texts* and *Forms*. But an ODBC (Open Database Connectivity) database subsystem is planned for the second release, and Oberon Microsystems says that several U.S. and European consulting firms plan to develop and market additional components. In-place editing of industry-standard graphics and spreadsheet formats won't be available until a later release supports OLE 2.

The Texts subsystem is a word processor with features that are roughly equivalent to Windows Write—it supports fonts, paragraph attributes, and object embedding. Unlike with Write, however, you can extend this editor in any way you like. As a test example, I decided to add the ability to change a selected passage of text into uppercase (see the code in the listing "Extending the Oberon/F Texts Component"). A rather minor achievement, you might think, but consider these points:

❶ This is not just a WordBasic-style macro but rather a native 486 code extension to the system.

❷ This new ability is available within any piece of text in Oberon/F and will continue to be available in any future programs that I add.

❸ I did not need to recompile the text editor and, indeed, have never even seen its source code, only the published programming interface.

❹ This same code works identically on a Windows PC or on a Mac and automatically displays the proper "look and feel" of either platform.

In Oberon/F, exported parameterless procedures are called *commands,* and they are executable from anywhere in the system. The procedure UpCase* (the asterisk indicates that it's to be exported by the module DickText) is a command that performs its action on the selection of the window that currently has the focus.

You can program Oberon/F at three levels of complexity, and my example illustrates the simplest command programming that adds new functions to an existing view. The next higher level is the writing of new views, which are visual representations for data types. The third, and hardest level, is the writing of container views that can contain other embedded views. Oberon/F editors are normally container views.

The Forms Component

The Forms component is a simple visual design tool for data-entry forms and dialog boxes. First, you write a code module that defines a record data type with various fields, and then you design the corresponding form by visually dragging control objects around on it as you would in Visual Basic. Thereafter, the Oberon/F run-time system creates and maintains the connections between the screen fields and the underlying data structure without your having to write any further code, automatically updating the field variables whenever you enter data into the form. The reverse process is not automatic, so when your program updates a record field, it must broadcast an update message telling all screen views that they need to change, too.

Oberon/F forms are stored as documents. You can modify their appearance without forcing a recompilation of the application code, a great advantage compared with conventional code generators. You can embed forms in texts and vice versa, recursively to any depth, to construct a variety of user-interface styles.

Models, Views, and Controllers

Oberon/F is designed around a hierarchy of abstractions that isolate modules from the physical hardware (for cross-platform portability) and from one another (for extensibility). The physical display, printing, and file systems are hidden in abstract object classes and are accessed by creating reader and writer objects for them.

The most fundamental data type is a Store, which represents a body of persistent data that knows how to save and retrieve itself from a nonvolatile medium like a hard disk. The module Stores supplies readers and writers that can map Oberon 2 data types—such as characters, integers, sets, and other stores—into binary data. Stores can contain other embedded stores and, hence, can represent compound documents. Store is an abstract type that is never instantiated directly; instead, Oberon/F supplies three extensions of Store called *Models*, *Views*, and *Controllers*. This MVC (Model-View-Controller) paradigm was originally devised by the SmallTalk team at Xerox PARC.

Crudely put, the model is the data, whereas a view is a particular presentation of the data transformed into a rectangular display area. There may be many views onto the same model, and if the model is changed, this fact must be broadcast to all the views by sending messages. A view might directly handle interaction with a user's mouse and keyboard, but in complex applications, this task is usually delegated to a Controller object. Models, Views, and Controllers are extensible. In the listing, you'll see the use of a TextController object *c* to measure the current text selection, but the actual processing takes place on a TextModel called *buf.*

Safety First

Although Oberon/F makes great use of inheritance internally (e.g., Stores –> Models –> TextModels), it strictly controls external inheritance to preserve extensibility by imposing the classic separation of interface from implementation. Many modules deliberately don't export concrete types used in their interface, which prevents application programmers from extending them directly. Instead, they let you merely create instances of a hidden concrete type, together with an abstract interface type that you can inherit to reimplement extensions of the type. This mechanism retains most—though not all—of the power of inheritance, but it's necessary to guarantee the future extensibility of the program's semantics without running into the so-called fragile base-class problem (see "Extensible Software Systems," May 1994 BYTE).

In the messy world of PC operating systems, Oberon/F's simplicity and austerity could hardly be more at odds with industry practice. C++ programmers like to party and then use industrial-strength debugging tools, like BoundsChecker and Purify, to clean up the mess afterwards. The Oberon 2 programmer expects to catch 90 percent of the errors at compile time and most of the remainder by careful choice of preconditions. Of course, adapting to changing requirements is the ultimate software challenge, and that's where Oberon/F shines. "If the paradigm of object orientation is promising," says Wirth, "this is mostly because object-oriented programming allows us to design genuinely extensible modular systems." ■

About the Product

Oberon/F
Commercial version......$350
Educational version.........free

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CH-4053 Basel, Switzerland
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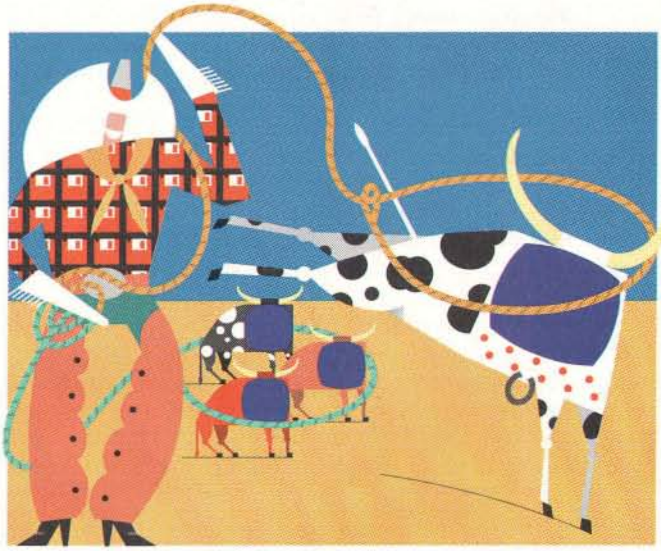
Daisy-Chain Ethernet

How Farallon Computing and Tut Systems make twisted-pair Ethernet wiring as flexible as PhoneNet

STAN MIASTKOWSKI



GERRY CHAPLESKI © 1995

Conventional wisdom says that you have two types of 10-Mbps Ethernet network wiring choices, depending on the topology you want to use. For bus, or daisy-chain, topology, there's thick RG-8 (10Base-5) coaxial cable or the more common thin RG-58 (10Base-2) coaxial cable. For star topology, you use 10Base-2 UTP (unshielded twisted pair) cable.

But two companies are challenging that wisdom with technologies that offer daisy-chain Ethernet using inexpensive and easier-to-install copper wire instead of coaxial cable. Farallon Computing's (Alameda, CA) EtherWave does the job with two pairs of standard Level 3 or Level 5 UTP. Tut Systems' (Pleasant Hill, CA) Silver Streak stretches the technology further by putting full 10-Mbps Ethernet on a single pair of wires of virtually any type, including the nontwisted "silver satin" flat phone wire that's used to connect telephones and modems to telephone jacks.

Your network wiring is the physical layer, the first and essential layer of the seven-layer ISO OSI (Open Systems Interconnection) LAN model. Coaxial cable has been used for daisy-chain bus topology for the simple reason that its robust electrical characteristics let it easily meet the signal integrity and compatibility standards of daisy-chain connections. But the IEEE 802.3 Ethernet standard doesn't specify that coaxial cable *must* be used for daisy-chain networks.

Integrating Technology

Farallon's EtherWave integrates Level 3 UTP in a daisy-chain topology by combining 10Base-T hub and transceiver technologies into a single proprietary ASIC (application-specific IC) that's designed to handle the precise nanosecond timing needed for Ethernet. The ASIC is included on each network node, either in an ISA, NuBus, or PDS/LC NIC (network interface card) or in external connection boxes for AUI (attachment unit interface)/AAUI-equipped PCs, Mac PB adapters, LocalTalk network printers, or the Apple Newton.

EtherWave devices behave like nonreclocking repeaters, which allow users to add nodes to a 10Base-T network without impacting hop count limitations. Normal star topology 10Base-T networks are limited to four hubs (hops) between nodes, but EtherWave does away with this hop limitation. EtherWave also handles up to eight nodes per segment, with a total maximum segment length of 330 feet. However, for network expansion, each eight-node segment can be connected to any standard 10Base-T hub. For example, a 12-port hub can handle a total of 96 EtherWave-equipped nodes.

EtherWave includes auto-termination, which eliminates additional termination resistors at each end of the daisy chain (required with coaxial cabling). This proprietary technology senses impedance changes in the cable and instantly terminates or passes through the network signal. This scheme also allows shutting down or hot-swapping individual network nodes without shutting down the network, largely eliminating a major disadvantage of coaxial-based daisy-chain topology. In addition, EtherWave's ASICs incorporate Auto Crossover, sensing which wires are connected in the UTP and how they should be used. Auto Crossover eliminates keeping track of whether your 10Base-T cables are straight-through or crossover.

Analog Worlds

While Tut's Silver Streak offers nearly all the above advantages of daisy-chain topology without coaxial cable (except for the lack of internal auto-termination), Silver Streak's essential difference is its ability to use nearly any type of wire. In the digital world of computers, it's important to remember that LAN wiring carries analog signals (with the exception of fiber optics, there is no such thing as a digital cable). In fact, the essential part of every network is a transceiver, which translates digital data into RF analog signals for outgoing data and vice versa for incoming signals. Twisted-pair and coaxial networks have their transceivers integrated into the NICs; thick coaxial wiring uses external transceivers "tapped" into the cable run.

One of the major realities of cable—any type of cable—

is that it distorts signals. And because distortion increases with transmission speed (*frequency* in the analog world), pumping a 10-Mbps Ethernet signal through thin wiring is a technical challenge.

There are five distinct types of distortion: attenuation, intersymbol interference, NEXT (near-end cross talk), noise pickup, and radiation. Each causes problems that slow data transmission. Interactions among these types of distortion result in a morass of problems that must be overcome to put full 10-Mbps Ethernet on standard flat telephone cable. Silver Streak uses a variety of approaches to solve these problems.

Attenuation When it comes to high-frequency signals, speed kills. RF signals ride on the surface of a copper wire in what's called the *skin effect*. The thinner the wire, the smaller the circumference, the less surface area, and the greater the amount of signal attenuation. In addition, attenuation increases as the square root of frequency (e.g., quadrupling the frequency doubles the attenuation, cutting the signal level in half). Standard 10Base-T Ethernet using Level 3 or Level 5 (both 24-gauge) UTP is limited to 330-foot segments, because beyond that distance, the signal is attenuated to the point where it no longer meets 802.3 standards. The attenuation problem would seem, at first glance, to be sufficient reason why you normally can't use the 18-gauge wire in standard silver satin telephone cord for Ethernet. But if you control the other aspects of distortion, especially noise (see below), flat telephone wire becomes usable.

Intersymbol Interference After passing through the NIC's transceiver, digital data travels through network wiring as a series of analog DC pulses (each pulse representing a bit of digital data). The nature of DC pulses is that they have (when viewed on an oscilloscope) a fast rise time but a long decay (sometimes called a *tail*) because of the memory inherent in copper wire. At Ethernet speeds, this can cause pulses to interfere with each other, giving rise to errors, retransmissions, and slow network throughput. To combat intersymbol interference, a factor in all copper-wired networks, Silver Streak uses an equalizer circuit. Essentially a simple analog filter circuit that consists of two high-speed Schottky diodes connected back to back, it effectively cuts off the tail of each DC pulse, allowing full-speed Ethernet transfers without the pulses getting in each other's way.

NEXT Unless wire pairs are shielded (which they aren't in UTP), there is always some crossover of signals between the two pairs of wires used in 10Base-T wiring (this is comparable to what happens when you hear another conversation in the background while you are talking on the telephone). Wire pairs that touch each other couple capacitively, and fast-rise time pulses (i.e., Ethernet signals) travel easily through capacitors. This causes noise, collisions, and slow network throughput. The twists in twisted pair minimize cross talk by minimizing the capacitive coupling between wire pairs for two reasons: The distance between pairs is random, and individual conductors are not in constant contact with each other. In Level 3 and Level 5 UTP, this causes null effects that essentially cancel out the cross talk. In standard silver satin phone wire, where pairs are not twisted, NEXT would be unacceptable at Ethernet speeds. However, NEXT is eliminated when only a single pair of wires is used for concurrent transmitting and receiving, instead of the dual pair arrangement used in standard 10Base-T setups. Silver Streak uses this single-pair method.

Company Information

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fax: (510) 814-5020
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Silver Streak
Tut Systems, Inc.
2446 Estand Way
Pleasant Hill, CA 94523
(510) 682-6510
fax: (510) 682-4125
Circle 1008 on Inquiry Card.

Putting both signals onto a single wire pair at the same time is trivial. All that's needed is a simple hybrid circuit—essentially the same thing found in any telephone set—letting you talk and listen at the same time. So why isn't a single pair with hybrid circuit used in UTP to eliminate NEXT? Mainly, it's because NEXT is a minor problem compared with noise.

Noise This is by far the biggest and most difficult problem in copper-wired networks. By definition, electrical noise is any unwanted disturbance that interferes with the signal. Any wire is a receiving antenna, and every office environment is rife with noise sources that adversely affect a network. Fluorescent lights, AC power lines, and the RF fields generated by PCs can interfere with network wiring. There are more-serious problems, too. The normal voltage carried in Ethernet wiring is approximately 2 VDC. However, a static shock caused by walking across a carpeted floor can put a 6000-V spike on network wiring. Ringing signals on analog telephone systems use 180 VDC, and network and phone signals are often run together, using the extra pairs in UTP.

The key to Silver Streak's ability to use virtually any wire is a proprietary balun (short for balanced to unbalanced). All networks use baluns, which are transformers that connect the NIC transceiver to the physical wiring. All baluns attenuate noise, and the baluns used in most network hardware attenuate at about a 100-to-1 ratio (40 decibels). Unfortunately, this isn't enough to attenuate serious—yet common—noise sources below the point where they cease to interfere with network transmissions. Tut's proprietary balun is unique, rejecting noise by a ratio of 10,000 to 1 (80 dB). It attenuates virtually all noise, even the most serious, below the point where it affects the network. The balun and lack of noise is also the reason that a Silver Streak segment can extend up to a length of 800 feet with a maximum of 30 nodes per segment. Like Farallon's EtherWave, the total number of nodes in a Silver Streak installation can be extended by using standard 10Base-T hubs.

Radiation This is the other side of the noise coin, because all wires carrying signals are transmitting antennas, which radiate RF energy that can interfere with televisions, radios, and other electronic equipment. But properly done noise reduction also minimizes radiation from wiring, and Silver Streak's balun keeps radiation to a minimum. In fact, Silver Streak is the only network system that meets the stringent FCC Class B standards for consumer-level equipment. All other networking systems meet the less-stringent FCC Class A standards for commercial equipment and applications.

Wiring Choices

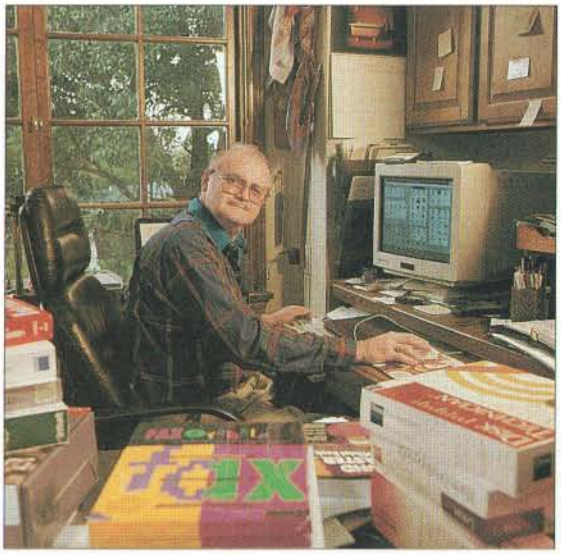
Farallon's EtherWave and Tut's Silver Streak open up new horizons for installing new networks and for expanding existing installations without major investments in wiring. Although the details of how each implements daisy-chain Ethernet with copper wiring are different and largely proprietary, the crucial fact is that both systems are 100 percent compatible with all 802.3 Ethernet specifications (10Base-2, 10Base-5, and 10Base-T). ■

Stan Miastkowski is a BYTE consulting editor who has been writing about networking and communications technology for over 16 years. He is the coauthor of Windows for Workgroups Bible *(Addison-Wesley, 1993). You can contact him on MCI Mail at 530-9979 or on the Internet or BIX at stanm@bix.com.*

JERRY POURNELLE

Communications Issues

A visit to the Interop Conference in Atlanta reinforces Jerry's belief that networking is very important



AMY ETRA © 1995

Due to a bizarre accident, I'm typing this with one hand while keeping my left hand and arm elevated. It looks silly and does little for my disposition. I suppose I should take it as a lesson in patience.

Before I got my wrist punctured, I went to the Interop Conference in Atlanta. If I hadn't already been convinced that networking is important, that would have done the trick. While Interop wasn't quite as big as Spring Comdex, it wasn't a lot smaller, and it was all devoted to connectivity.

We saw Cisco Systems, which had new additions to their routers (i.e., devices for interconnecting independent networks and sharing WAN resources); Zenith's Z-Stor Personal Server, which painlessly adds peer-to-peer capability to your NetWare client/server system (more later); Microsoft Daytona, also known as Windows NT Server 3.5; a whistle (our own collective noun) of modems from various manufacturers; and all kinds of communications hardware and software. Bell Atlantic tells me there were over 80 ISDN (56- to 128-KB phone lines—many claim it stands for I Smell Dollars Now) and 500 T1 (1.544-Mbps data pipes) connections brought into the Congress Center for this show. That's a lot of bandwidth.

I put off my decision to go to Interop until all the hotels were full and thus ended up in a cheap motel far from downtown. Of course, this had to be the trip where the local congressman wanted me to show him the Internet. So there I was with Newt Gingrich in the least fancy room in Atlanta. This wouldn't have been remarkable except that the phone lines were ghastly, and we got a line spike that deep-fried my Supra modem just as I was showing off the joys of E-mail and BIX.

I was working with the new Zenith Z-Noteflex portable, a neat color system that's about the size and weight of my old Zenith Mastersport. However, it is faster and has a much larger hard drive, more memory, and color. I've named it Zeno, and I like it. The only complaint I have is that although the keyboard is all right, the old Mastersport keyboard has a better look and feel. Alas, I had just gotten Zeno, so I had no internal modem installed. I have several PCMCIA-slot modems (the Z-Noteflex has two PCMCIA slots), but I hadn't brought any with me.

Fortunately, because the Z-Noteflex is new, I had brought the Mastersport with its 2400-bps internal modem as a backup. The bad news was that for some reason that machine wouldn't boot, so I couldn't resume my demonstration of networking. Newt went home, and I went to bed.

Next day I lugged my bags to Interop, because that night I was scheduled to go to Washington, D.C. When I got out on the show floor, I ran into Marty Winston and told him my tale of woe. "You shouldn't have any trouble finding a modem," he said. "Just ask." It turns out he was right: I left Interop with three PCMCIA modems. The next day, two more PCMCIA modems and a new SupraFaxModem 288 arrived via Federal Express at my Washington hotel, but by then I had communications well in hand.

One of the modems I received in Atlanta was a Data Race RediCard RC-1496 data/fax modem, which features V.32bis 14.4-Kbps send/receive data and 9600-bps send/receive fax

ILLUSTRATIONS: MARY ROSS © 1995

capabilities. It consisted of a PCMCIA Type II card and a small cable that connects the card to the phone. That's all I got. When I got to the Marriott in Washington, I slipped the card into the Z-Noteflex, plugged the cable into the data port—thank you, Marriott—and turned on the Z-Noteflex. It made a couple of noises on boot-up, flashed a message that it saw a card in slot 3, and went into Windows. I opened Procomm 2 for DOS under Windows, and voilà! Not only did it work, but I could connect to one of the really troublesome Washington phone lines.

I also found out how to boot my Mastersport. For some odd reason, it boots fine on (the newly rebuilt) batteries but not when connected to wall power. Once it's booted, it runs fine with the charger plugged in. I offer no explanation. Other than that glitch, it's as reliable as ever.

Later I experimented with a couple of other PCMCIA cards; apparently they need setup software, because the Z-Noteflex didn't acknowledge they were present. I also tried the replacement SupraFaxModem 288 (working off the serial port), and it worked fine with both Zenith machines. I don't know what that awful line in Atlanta would have done to the Data Race modem. For that matter, I can't be certain the old Supra modem didn't just choose that moment to die: I've carried it all over the world, it has never been treated gently, and this was the first problem I ever had with it.

In all fairness, I should try some of the other PCMCIA-card modems with their installation software, and I really will do it, but the Data Race RediCard RC-1496 was plug-and-play at a time when I was desperate. It works as well as any portable modem I've ever had. Recommended.

Communications are increasingly important. Item: the new IBM OS/2 will come with access to the Internet and instructions on how to do it, plus local access to the IBM-owned network that carries Prodigy.

Item: Microsoft wants its own local-access network and will need serious network capability to compete with the new Internet capabilities IBM will furnish with OS/2.

Item: there are now secure systems for encryption and source authentication that work on the Internet. The guy who wrote PGP (Pretty Good Privacy) has made a deal with RSA, and public-key-encryption systems are available to everyone. They can even be used overseas legally. Such encryption and authentication methods can provide communications secure enough to work with banks over the Internet.

Put those together and it's another new world. Banking? Write checks by Internet; then each evening, Quicken goes out to find the daily balance in your accounts.

Wedding and christening pictures? Scan them in—I have a neat new box that claims to be scanner, copier, and fax machine all rolled into one—and distribute them electronically to all the relatives. You can also use this means to distribute political mail.

Everyone will get floods of E-mail, so much that we'll all need intelligent agents to deal with it. One I'd like—I may have to write it myself—would be a daemon that sorts my mail, indexes and files most of it, and shows me the mail from people on the hot list—there are a few PR people who never send me junk mail—and other stuff it considers important. Later, when deadlines loom, I can ask "What's new?" and get a good summary, ask for details,

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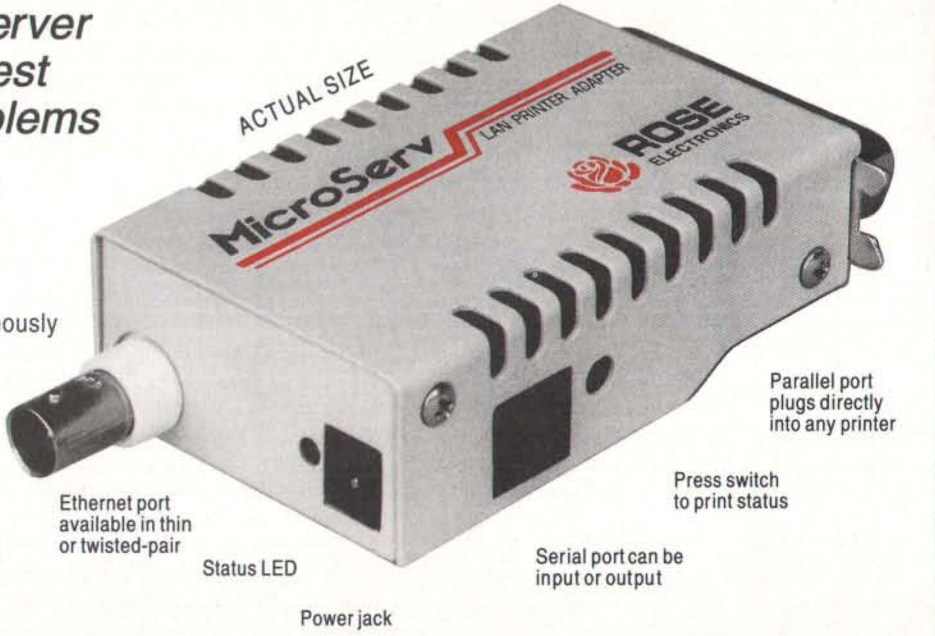

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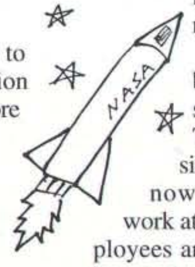
and so forth. Also, with remote-query services like gopher, I could ask someone else's big database about what was new. I could search the Internet's comp.sys.novell group for information on using NetWare with the NetBEUI protocol.

For those new to the Internet, gopher is a program that runs on some Internet computers—the University of Minnesota is one that has a gopher—at your command. Gopher is provided as a public service, and its operation is paid for by the facility where it resides. You tell gopher what you're looking for, and it goes net surfing for you. Eventually, it reports all its findings. Gophers are supposed to be used for serious research, but they're also used to collect digitized pornography. Every now and then, you hear about a scandal when pornographic files are found at some military or university computer facility.

The Internet is billed as an information superhighway, but it isn't that. At the moment, it's an experiment in self-organized anarchy. That's not likely to change for a while, either. It seems to me we're headed for the situation described in Vernor Vinge's fine novel *True Names* (out of print), with a large dash of his *A Fire Upon the Deep* (Tor Books, 1992), but we aren't there yet. If you haven't read those, they're a look at a future we may get to.

The reason I went to Washington was to take part in a big roundtable discussion on the future of NASA and space. More on that another time, but I'm pretty hopeful about the near future. NASA Administrator Dan Goldin made it clear that the old game of leaping to build a "National Transportation System" that excludes everything else is over. The new approach will involve cooperation with industry and development of technologies through X programs, such as Delta Clipper. That, at least, is what I heard, and I like that.



When I got home, Zenith's Z-Stor Personal Server was waiting. This is a small box containing a CPU, SCSI controller, and hard drive loaded with Personal NetWare, the successor to NetWare Lite. Personal NetWare is a peer-to-peer networking system from Novell.

If you already have an Ethernet (or Token Ring) installation, you can add Z-Stor absolutely painlessly; just plug it in and follow directions. It will take about an hour. If you don't have an Ethernet setup, you'll need cards for each of your machines, and you can add about half an hour for each machine in addition to the hour getting Z-Stor going. I'm allowing time for you to drop screws, plug cables back in, and so forth.

Z-Stor will install alongside your regular NetWare network and add peer-to-peer capabilities to that. It will also work as a stand-alone network, allowing file and printer sharing. It does *not* have the small applications like scheduling that come with Microsoft Windows for Workgroups networks. If I had to choose between bare-bones Personal NetWare and networking with straight W4WG, I'd generally prefer W4WG unless security were a problem. Novell hasn't built quite as many security features into Personal NetWare as into regular NetWare, but there are plenty of them. Moreover, Personal NetWare has provisions for a systems manager; W4WG does not. Personal NetWare also maintains logs of user activities.

Let me describe a typical installation for Z-Stor. Consider a small business office, say a doctor or an architect. There are several machines, none linked. The owner decides to try networking and buys the Microsoft W4WG starter kit plus enough Intel EtherExpress boards to link all the machines in the office. This is amazingly easy to set up, but then some limits appear, such as an inability to link to the Apple machine down the hall. Printer sharing is possible, but it's slow and no fun at all.

The owner decides to bite the bullet by getting a fancy new server and installing NetWare. That requires bringing in outside help, but it does work—only now W4WG is flaky or doesn't work at all. Meanwhile, the office employees are used to peer-to-peer operations and want them back. (After all, Joe used to let Paul connect to his computer; why can't he now? Sure, Joe's computer crashed without a backup, but it was awfully convenient.)

This is a perfect case for Z-Stor. Buy it, uncrate it, find a place for it to sit, start it up, and link it in; in an hour, you'll have your peer-to-peer operations back. And, because all the data will be in one place, you can actually back it up.

I have not yet got this linked up to the Mac and OS/2, although I believe it is possible. Certainly there are modules for regular NetWare that can link in DOS, Mac, and OS/2 (plus, they say, NT) systems. At the moment we have a hybrid: an Ethernet on which runs OS/2 Advanced Server, NetWare, Personal NetWare, and W4WG. Not all machines are linked by all systems, and sometimes the only way to get from one machine to another is to invoke LapLink for Windows, which also does

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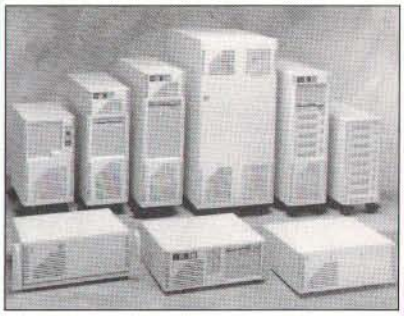

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file sharing over the network.

Of course, those multiple networks run on one wire; Ethernet is Ethernet. No matter what protocols might be running on the wire, they all stay out of each other's way. Those protocols can be translated (which NetWare excels at), or one computer can be multilingual.

My goal is to have one (logical) network that encompasses all my machines. It will allow all machines access to both the Pioneer New Media Technologies DE-UH7101 WORM/rewritable and Maxoptix T3-1300 optical drives, Palindrome's backup system with the Fast 2000 DAT (digital audiotape) drive running Network Archivist, Pioneer's DRM-604X Minichanger CD-ROM drive, the HP LaserJet III printer, Fargo Electronics' Primera color printer, Kyocera's Ecosys printer, and the Fax<HQ fax server for sending and receiving faxes. It will also have convenient ways I can use the little Xircom Pocket Ethernet Adapter III parallel-port box to attach my portables to the system. When it's all done, the little Z-Stor box will be a welcome part of that system. More on this in months to come.

That Fax<HQ system—it's a Windows-based program, though it needs an Intel Satisfaxtion board to do the faxing—is quite good. My major complaint is that you can't use it with all your computers. That's damning with faint praise, though—no one builds a single network faxing program that supports Mac, Windows, and OS/2 systems. Right now, anyone with a network of PCs and Macs would need two boxes to support faxing for the whole network. Oh, well.

There is an alternative to NetWare. Windows NT Server 3.5 also provides network services. Moreover, it's possible to set up an NT server that interfaces with a NetWare network in such a way that all your Windows machines see is a Windows software interface. Obviously, W4WG runs on the machines running Windows, so you won't need Z-Stor and Personal NetWare; but you'll have complete access to all the features of NetWare.

And yet another alternative: OS/2 Advanced Server speaks more or less the same network protocols as W4WG, and the two can be interfaced with a certain amount of work. OS/2 Advanced Server is a client/server system comparable in features and complexities to NetWare. Meanwhile, Artisoft now provides a LANtastic for OS/2 peer-to-peer network. You can set up your systems in Windows; change over to OS/2 Warp, which wraps around Windows or W4WG; add LANtastic for OS/2; and have both peer-to-peer and client/server capabilities. Whether that would be superior to NT Server 3.5 depends on who you listen to. They both seem to work.

I should make it clear that while I have the software to do all these operations, I haven't tried most of them so far. This is partly due to lack of time, but also because I'm about to get some new server hardware, including a RAID system. Meanwhile, I intend to continue experimenting with what I have.

One of the nice features of LANs is network printing. Pournelle's laws say that sharing CPUs, even with yourself, is undesirable. Any printer attached to your PC steals cycles; big print jobs in Windows steal lots, and it's even more disconcerting when your computer slows down because of someone else's print job.

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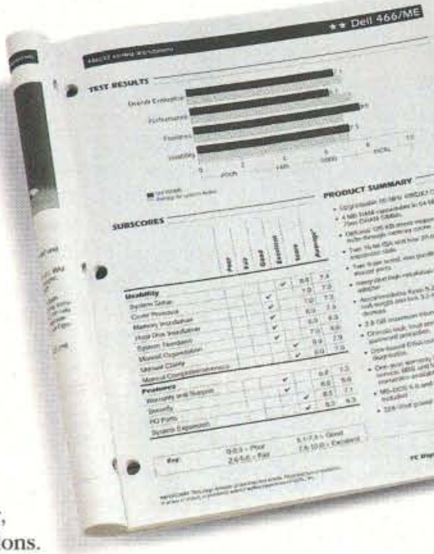

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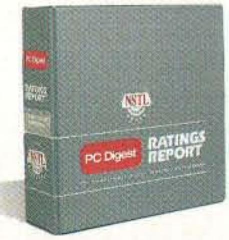

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network, so no more sharing CPU cycles or restarting jobs because your computer hung up. Just send a job to the server (at Ethernet speeds, and all at once) and go back to work. The network parcels the work out at print speed.

If you can't hook your printer directly to the server, you want a printer with a built-in network interface (Hewlett-Packard makes excellent plug-in cards for theirs). Older printers like my LaserJet III don't have this slot, so we bought a Digital Products NETPrint/150 network print server to hook up all three of our parallel printers to the Ethernet. They also have some models with a single parallel port, as well as boxes for Token Ring and networks like Banyan Vines.

Now, if I want to print a whole manuscript, I blast it all to the network server and go back to work. The NETPrint/150 is easy to install and use. Digital Products have a BBS with the latest software, and their technical-support people are helpful and patient, should you need them.

Traveling Software does it again. If you don't have LapLink 6.0 for Windows, go get it. It works, and it's worth the expense.

I confess I didn't bother to upgrade from LapLink Pro (which is LapLink 4.0) to LapLink 5.0. LLPro works fine on just about every machine I have. It runs as a DOS program under Windows and comes with the .PIF and .ICOn files needed to set it up. Because most of my portables now do Windows, that's how I use it.

LLPro works with W4WG. If the computer you connected your laptop to can see the network, LLPro can, and you can transfer from the laptop to a remote machine. LLPro is hard to beat as a means of putting files on your laptops and peeling them off after a trip. All versions of LapLink from 3.0 and higher have come with a "synchronize directories" feature, making it easier on road warriors.

LapLink 6.0 for Windows adds a number of desirable features to LLPro. For one thing, it works over an Ethernet, so you can use one of Xircom's Pocket Ethernet Adapter III parallel-to-Ethernet boxes to speed things up. For another, it uses a block-by-block file-comparison system. This doesn't speed up the first synchronization of files, but if you synchronize files on two machines very often, the "delta technology" takes over so that only changes in the two files are transmitted, speeding things up something wonderful.

This is especially important if you're doing file transfers over a modem. You can use LapLink 6.0 for Windows to control one machine from another. On the road, I can use my portable to call my big machine, get in with the proper passwords, and operate my system as if I were at home. Clearly, that can be slow on a 1200-bps modem line, but because of object caching and the delta technology, it's nowhere near as slow as you'd think, because only changes are sent. It's possible to update a large Microsoft Word document on my home machine through a modem from a hotel room. For that matter, I can cause my home system to create and send a fax.

Also, the new LapLink will maintain multiple simultaneous connections—up to eight—over the LAN, modems, AirLink, or the familiar LapLink cables. Mark Eppley, president of Traveling Software, brought three laptops over to show this feature off; Moe, Larry, and Shemp ("Curly is back in Bothell") talked to each other, one via telephone and one through Ethernet. He had two windows open, transferred data from one remote machine to another, and generally looked like a proud papa showing off his new son.

Alex pointed out how wonderful this would be for system administrators—leave the connections "nailed up" but minimized until some user calls with a question. Programs such as PC Anywhere and Carbon Copy can do similar things, but none have LapLink's connectivity and familiar pedigree.

LapLink 6.0 for Windows can be installed on a DOS machine, so it will link DOS and Windows systems. It understands lots of modems, including wireless as well as ISDN. Sometimes it's the only way I can transfer files among the screwy systems on my hybrid network; if LapLink 6.0 for Windows can see the other machine, it sees it by name and knows how to get at all its drives.

Our first attempts to use LapLink 6.0 for Windows did not work, because we were testing Cybermedia's FirstAid for Windows. FirstAid is a good program. It operates like a Mac INIT and watches to see what you're doing; if something goes wrong, it tries to let you know about it. We like FirstAid, and I'll have more on it another time.

I bring it up here because the present version is not compatible with LapLink 6.0 for Windows. This conflict is inherent. Most programs that try to operate Windows remotely do it by changing Windows drivers. LapLink 6.0 for Windows doesn't do that, but instead burrows in under Windows so that Windows doesn't know it's there. Unfortunately, so does FirstAid, and the two clash at a fundamental level. The result is that LapLink

6.0 for Windows thinks it doesn't have enough memory and quits. The two companies are discussing this and will likely have a solution by press time.

We also found some minor problems with W4WG, and indeed made the discovery that W4WG uses up memory in ways that Windows 3.0 and 3.1 do not. Traveling Software has already fixed the installation problem that caused. LapLink 6.0 for Windows is pretty solid, more so than the other remote PC programs; our only problems were with installation.

If you haven't upgraded your LapLink lately, it's probably time. LapLink 6.0 for Windows is seriously good stuff. Recommended.

If you're looking for a world-class correspondence program, I've got it. Accent 1.0 from Accent Software International is a Windows word processor that can write in 34 languages and five alphabets: Western European and Scandinavian, Central and Eastern European, Cyrillic, Turkish, and Greek. It checks spelling in 17 languages. There are plans to add Hebrew and Arabic.

It's not all that bad as a word processor, either. It looks and feels a lot like Microsoft Word, and it can import and export to Word, WordPerfect, and Ami Pro. It has some Internet features I haven't tried, but for those who must do electronic correspondence in many languages, I'd think this would be a godsend.

Free idea: someone could easily make up fill-in-the-blank template letters for Accent pointed to individual industries. Fill in the English proper names, and out comes an (admittedly idiomatic) equivalent in another language, ready for faxing. I think this "limited automatic" translation could be quite useful, as long as it avoids converting "Coke adds life" to "Our cola revives your ancient ancestors."

BOOTCON 2.1 is a program that lets you set up about 100 CONFIG.SYS and AUTOEXEC.BAT initializations and then choose them from a menu when you reboot the system. I keep it on my experimental machines. Typical installations are the GAME setup (which loads Sound Blaster and the CD-ROM driver and nothing else), WINDOWS FOR WORKGROUPS ONLY, WINDOWS WITH NOVELL, and so forth. BOOTCON will also let you keep different Windows .INI files and choose among them when you boot up.

I've used BOOTCON on my experimental machines for years. Not only has it always worked, it often saves my bacon by letting me go back to a known workable boot-up combination after I've been experimenting with CONFIG.SYS or WIN.INI. The one gripe I've had with BOOTCON is that every time any controlled file changes after boot-up, at the next boot-up, BOOTCON makes me decide whether I want to keep the new configuration or go back to the old one; but because it doesn't tell me what lines have changed in, say, WIN.INI, I get confused.

The new version of BOOTCON will let you compare the new and old versions of WIN.INI, AUTOEXEC.BAT, and so forth before you decide whether or not to keep the updates. You can also disable BOOTCON to optimize your current boot-up initializations and then add your new CONFIG.SYS and AUTOEXEC.BAT to BOOTCON's list. And the newest version transparently makes up these files each

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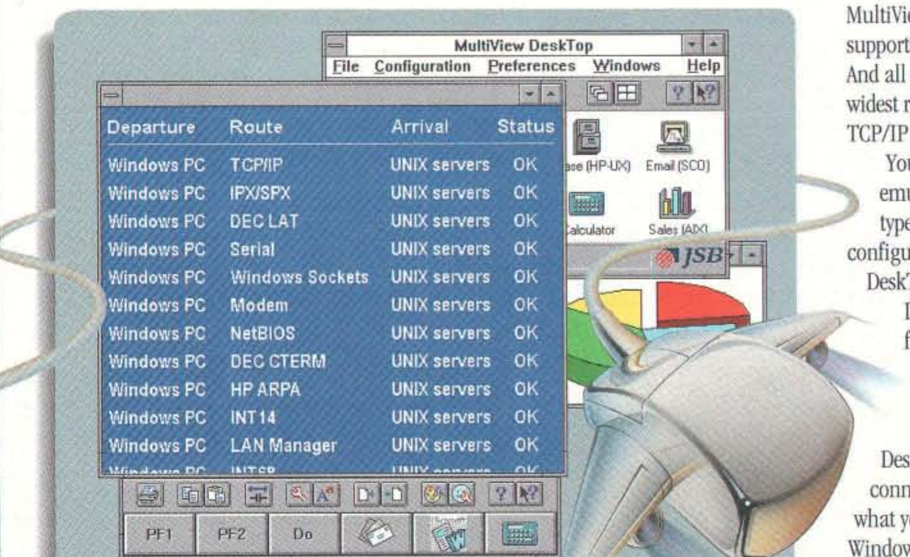

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time instead of putting them in one big file—thus removing my second major complaint. You can now use QEMM's Optimize without defeating BOOTCON.

MS-DOS 6 and higher have a BOOTCON-like feature, but Modular Software Systems' program is much more sophisticated. It can even reconfigure your bootup depending on the time or day of the week—a pretty secure way of defeating remote access on a dial-up PC on the weekend, for instance.

If you do much tinkering with your system, you definitely need BOOTCON 2.1. Recommended.

Microsoft, having found great success with mice, has brought out an ergonomic keyboard, the Microsoft Natural Keyboard. It sort of humps up in the middle, with a section for each hand; those are separated by an inverted *V* of blank space at the apex of the bump. Your hands come in at a 45-degree angle to each other to meet up with the keys. This feels unnatural at first, especially if you watch your hands while you type. The thing is about 3 inches tall, so you won't get your slimline keyboard drawer to close on it.

Unlike the Apple Adjustable, the Microsoft Natural Keyboard is all one piece; you can't adjust the two home halves or bring them together like a normal keyboard. For that reason, it will be beloved by typing teachers and cursed by crossover typists—anyone who types *b* with their right hand will hate it. The touch is light and fast, and the plastic construction makes it much lighter and less tough than the Northgate OmniKey Ultra keyboard I use.

The installation disk has control panels for adjusting the keyboard's performance: international and proprietary keyboard layouts, using the numeric pad as a mouse, key repeat rate, and the like. If you'd like to experiment with a Dvorak keyboard layout, you can try that, too.

There are other improvements I'd make. You can't make "keyboard salad"—mix and match the key assignments. I'd want to put the Backspace key up above the Enter key, as on an IBM Selectric typewriter (and on the Pournelle-configuration Northgate keyboards), and swap Caps Lock and Control. Actually, I'd as soon have Caps Lock up on the function-key row so I wouldn't hit it accidentally. If you were heavily into desktop publishing or occasionally used foreign characters, you might want to assign the *å* and *õ* characters to a particular key cap to avoid the annoying Alt+0145 sequence, but that will take third-party software right now (Gateway's programmable keyboards let you do this).

As a silly bonus, you can cause your computer to make sounds when you hit a key—maracas, scissors, or manual or electric typewriter. The electric typewriter sounds were obviously taken from a Selectric, complete with the "golf ball" spinning when you lean on the Shift key and carriage return when you press Enter. I wonder if IBM will sue them for "sound and feel"?

Speaking of IBM, their former Lexmark division would do well to make a competing keyboard with the built-in trackpoint mouse from the IBM ThinkPad stuck in the middle. ThinkPad portables are so good they scare me.

I haven't made up my mind about the Microsoft Natural Keyboard. I've put it on the machine Larry Niven uses when he works here; he hasn't seen it yet. More on this later.

Pentafluge died the other day. When we turned it on, it gave a series of beeps. Those are the post codes that tell what's wrong. Alas, my Micronics Computers M5Pi motherboard was a late beta version, and I didn't get the full documents with it. Micronics rushed me a replacement motherboard, and I installed it—not difficult—and put in the 60-MHz Pentium chip, complete with its PC Power & Cooling chip fan.

When I turned it on, I got the same series of beeps. This time I had the documents and looked up 3-2-4: it said keyboard encoder failure. I turned over the keyboard and beat on it until some peanut shells fell out, and lo!, all was well. Longtime readers will recall I've had this problem before. Due to a peculiarity in PC design, the keyboard is part of the system, and the encoder is used for certain address handling. The moral of the story is check your keyboard before you replace your motherboard. In my case, the new M5Pi motherboard is a bit more finished than the older test version I had; but I never had any trouble with the old one. The second moral of this story is get your system documents and pay attention to them.

IBM has a neat new system called the Duchess-Blue. It's an integrated multimedia system that reminds me of Tandy's Fantasia. It comes with an integrated video accelerator, full wave-table sound (with the volume control in front), a game port, and a CD-ROM drive. It's very fast: it plays Doom like nothing you have ever seen. It's a small-footprint system with room for five cards (but has sound, video, and CD-ROM on the motherboard). It was simple to put in an Intel network card and connect it with W4WG.

I haven't had this long, and what with being one-handed, I haven't done much with it. But I intend to install the new OS/2 Warp on it, as well as a bunch of other stuff. You'll certainly hear more about it.

As I write this, the Duchess-Blue isn't available; IBM is negotiating with manufacturers who may bring it out under their product name. I'll let you know about that when I hear more. Meanwhile, if you're looking for an OEM source on a nifty integrated multimedia system, talk to IBM Microelectronics in East Fishkill, New York. This is a neat little machine.

I've had After Dark on most of the Macs and PCs for years, so I was pleased to see version 3.0. Perhaps *amused* would be a better word. After all, modern Energy Star monitors turn themselves off when inactive; After Dark is less a screen saver than an entertainment package. It does that well. For instance, version 3.0 comes with four-slice toasters and bread with jam. One new module, You Bet Your Head, is an oddball automated quiz show Chuck Jones would approve of, and the Bad Dog digs holes in your screen and pulls things around. Alas, his whining upsets my dog.

I'm as guilty as the next person of enjoying After Dark's antics; we have Boris the Kitten (from More After Dark) romping around on a world clock (from Palo Alto Software's After Dark add-on module) on the Mac Quadra 700. My main writing machine had Mr. Spock examining Hortas (from Star Trek: The Screen Saver) for a year or so. But you could hardly suggest that all this silliness was just to save your screen.

Fair warning: on the Mac, we couldn't get After Dark to install unless we turned off all the INITs, not just the virus-checking software they warn you about. But once done and the system rebooted, we had all the new modules, along with our old ones, available.

There were similar installation problems under Windows, but in both cases, the Berkeley Systems support people were helpful. Sure, Windows 3.0 and later come with a rudimentary screen saver, but can you really live without Bart Simpson skateboarding around your Program Manager?

The book of the month is Hy Bender's *Essential Software for Writers: A Complete Guide for Everyone Who Writes with a PC* (Writers Digest Books, 1994); it's humorous and well done. It discusses a lot of software of interest to those who use computers to write.

The game of the month is Strategic Simulation's Dark Sun Shattered Lands, a rather good fantasy role-playing game with a new game engine. It got me away from XCOM: UFO Defense for a few days. Alas, XCOM has still got me.

Next month, I'll have a lot more on networks and a whole bunch of new software. By then, I'll be able to type with both hands. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at jerryp@bix.com.

For More Information

For those who must do electronic correspondence in many languages, I'd think **Accent 1.0** ($379) would be a godsend. Contact **Accent Software International, Ltd.**, Jerusalem, Israel, +972 2 793723; fax +972 2 793731. **Circle 1150 on Inquiry Card.**

After Dark 3.0 ($49.99) is less a screen saver than an entertainment package, and it does that well. Contact **Berkeley Systems, Inc.**, Berkeley, CA, (800) 877-5535 or (510) 540-5535; fax (510) 540-5115. **Circle 1151.**

If you do much tinkering with your system, you definitely need **BOOTCON 2.1** ($79). Contact **Modular Software Systems**, Kent, WA, (800) 438-3930 or (206) 631-5781; fax (206) 631-5779. **Circle 1152.**

The game of the month is **Dark Sun Shattered Lands** (on floppy disk, $60; on CD-ROM, $65), a rather good fantasy role-playing game with a new game engine. Contact **Strategic Simulations, Inc.**, Sunnyvale, CA, (408) 737-6800; fax (408) 737-6814. **Circle 1153.**

If you're looking for an OEM source on the nifty **Duchess-Blue** ($2199) integrated multimedia system, contact **IBM Microelectronics**, East Fishkill, NY, (800) 636-2426. **Circle 1154.**

The **Fax<HQ** system (standard package with one copy of Fax<HQ Gateway Fax Server software and 25 copies of the Fax<HQ client module, for a total of 27 users, $1295; Fax Server software and five copies of the Fax<HQ client module, $395; Expansion Kits to add 25 users, $695) is quite good. Contact **Headquarters Software, Inc.**, Pleasant Hill, CA, (510) 284-2877; fax (510) 284-3238. **Circle 1155.**

We like **FirstAid for Windows** ($49.95). Contact **Cybermedia, Inc.**, Los Angeles, CA, (800) 529-2373 or (310) 843-0800; fax (310) 843-0120. **Circle 1156.**

LapLink 6.0 for Windows ($199.95) is seriously good stuff. Contact **Traveling Software**, Bothell, WA, (800) 343-8080 or (206) 483-8088; fax (206) 487-1284. **Circle 1157.**

The new **M5Pi motherboard** (with a 60-MHz Pentium processor and 256-KB cache, $895) is a bit more finished than the older test version I had; but I never had any trouble with the old one. Contact **Micronics Computers, Inc.**, Fremont, CA, (800) 577-0977 or (510) 651-2300; fax (510) 651-5612. **Circle 1158.**

The **NETPrint/150** ($795) is easy to install and use. Contact **Digital Products, Inc.**, Waltham, MA, (800) 243-2333 or (617) 647-1234; fax (617) 647-4474. **Circle 1159.**

OS/2 Advanced Server 4.0 (on floppy disk or CD-ROM, $2066) is a client/server system comparable in features and complexities to NetWare. Contact **IBM Corp.**, Armonk, NY, (800) 342-6672 or (914) 332-2085; fax (800) 426-4329. **Circle 1160.**

Personal NetWare ($99) has plenty of security features, provisions for a systems manager, and maintains logs of user activities. Contact **Novell, Inc.**, Provo, UT, (800) 453-1267 or (801) 429-7000; fax (801) 429-5155. **Circle 1161.**

With the **Pocket Ethernet Adapter III** ($349), I have a convenient way to attach my portables into my network. Contact **Xircom, Inc.**, Calabasas, CA, (800) 438-9472 or (818) 878-7600; fax (818) 878-7630. **Circle 1162.**

The **RediCard RC-1496 data/fax modem** ($299; RC-1414 with 14.4-Kbps send/receive fax, $349) was plug-and-play at a time when I was desperate, and it works as well as any portable modem I've ever had. Contact **Data Race, Inc.**, San Antonio, TX, (800) 329-7223 or (210) 558-1900; fax (210) 558-1929. **Circle 1163.**

The **SupraFaxModem 288** ($269.95) worked fine with both Zenith machines. Contact **Supra Corp.**, Albany, OR, (800) 727-8417 or (503) 967-2400; fax (503) 967-2401. **Circle 1164.**

It's possible to set up a **Windows NT Server 3.5** (server license, $699; client access license, $39.95 each) that interfaces with a NetWare network in such a way that all your Windows machines see is a Windows software interface. I'll have more on the **Microsoft Natural Keyboard** ($99.95) later. Contact **Microsoft Corp.**, Redmond, WA, (800) 426-9400 or (206) 882-8080; fax (206) 883-8101. **Circle 1165.**

The **Z-Noteflex** ($3222) portable is a neat little color system. I like it. With the Z-Stor Personal Server ($999), you can have peer-to-peer network operations in about an hour. Contact **Zenith Data Systems Corp.**, Buffalo Grove, IL, (800) 533-0331 or (708) 808-5000; fax (708) 808-4483. **Circle 1166.**

What's New Hardware

POCKET PRINTER?

You wouldn't want to use the 1-pound PN60 portable laser-quality printer while it's in your pocket, but in a pinch you can pop the unit in there to free your hands for some last-minute updating prior to printing your color transparencies. Available for the PC and the Mac, the PN60 ($429) measures 10 by 1.85 by 2 inches and prints up to 2 ppm. The thermal-fusion-based printer operates at a noise level of less than 46 dBA. It comes with five built-in fonts and also supports TrueType and Adobe fonts. A monochrome cartridge can print up to 30 text pages and up to 18 graphics pages; the optional color cartridge can print from three to five color transparencies.

Contact: Citizen America, Santa Monica, CA, (310) 453-0614.

Circle 1271 on Inquiry Card.

PORTABLE PRINTING FOR THE MAC

For Mac PowerBooks, the HP DeskWriter 320 printer ($379) has a resolution of 600 by 300 dpi. The portable 4-pound unit can print more than three pages of black text per minute and a color page in about 4 minutes. From Hewlett-Packard (Santa Clara, CA), the unit includes the company's ColorSmart and Resolution Enhancement technologies. The optional color kit ($49) consists of a snap-in cartridge and storage case; the optional cut-sheet feeder ($99) can automatically feed up to 60 sheets of paper or 20 transparencies.

Phone: (800) 752-0900.

Circle 1274 on Inquiry Card.

COMPUTER-CONTROLLED OUTLETS

A power-control device that can be daisy-chained to provide up to 156 individually controllable outlets, the Pow-R-Bar ($149.95) connects to your PC via the serial port. From International Micro Electronics Group (Lexington, KY), the devices (up to 26 Pow-R-Bars) can be up to 50 feet apart, and greater distances are possible when you use them with short-haul or phone-line modems.

Phone: (800) 274-8699 or (606) 271-0017.

Circle 1275 on Inquiry Card.

FOUR PORTS ON A BOARD

Each of the four serial ports on the Model 3PXCC4A serial card ($209.95) can be independently configured for any I/O address and IRQ, as well as for RS-232, RS-422, or RS-485 data protocols. From B&B Electronics Manufacturing (Ottawa, IL), the card has interrupt-sharing capabilities as well as an interrupt-status register.

Phone: (815) 434-0846.

Circle 1277 on Inquiry Card.

FOR YOUR EYES ONLY ▼

The wraparound design of the PF50 filter ($119) from 3M Optical Systems (Roseville, MN) preserves the privacy of travelers who use their notebook computers in public places. The screen is legible only when it is viewed from directly in front of the display. An antiglare feature improves contrast and reduces glare.

Phone: (800) 553-9215 or (612) 733-4403.

Circle 1297 on Inquiry Card.

SAFE DATA TRANSFER ▶

The Datasafe V.Fast-class external data/fax modem is available for both the PC ($319) and the Mac ($329). From Logicode Technology (Camarillo, CA), the modem has built-in password protection, callback security, and remote configuration. Automatic fallback and fall forward ensure data transmission at the highest possible speed. The Datasafe automatically runs self-diagnostics when you turn it on.

Phone: (800) 735-6442 or (805) 388-9000.

Circle 1278 on Inquiry Card.

SHARE A PRINTER

Belkin Components' (Compton, CA) ParaShare II printer-sharing device (from $39.99) lets you select the printer of your choice via a Windows icon or DOS hot key. The ParaShare II uses a six-wire cable system to service four printers on four wires, which lets the device maintain consistent speeds as the printer-sharing network is expanded.

Phone: (800) 223-5546 or (310) 898-1100.

Circle 1279 on Inquiry Card.

TIGHTLY PACKAGED GENIUS

A C-programmable miniature controller board, the Little Genius ($149) is targeted at control and data-acquisition applications; it can also function as a core module to interface to your custom-designed boards. From Z-World Engineering (Davis, CA), the board has 14 digital inputs and 12 digital outputs (seven of which are high-current). It also has RS-232 and RS-485 interfaces, an EEPROM, and a power-fail interrupt.

Phone: (916) 757-3737.

Circle 1280 on Inquiry Card.

SERVING THE INTERNET

From BBN Internet Services (Cambridge, MA), the turnkey BBN Internet Server ($9895) uses the company's GUI-based software, which runs on Macs or under Windows. The Unix server supports all Internet-protocol client platforms, including Unix and OS/2, and provides general TCP/IP network transport over Ethernet, accommodating line speeds ranging from 14.4 Kbps to T1. The server provides access to such functions as the WWW and Gopher database servers, E-mail, the FTP file-retrieval server, and Network News BBSes.

Phone: (800) 632-7638 or (617) 873-8730.

Circle 1288 on Inquiry Card.

LAPTOP LIGHT ▶

A reading light for use with portable computers, the NCL—Notebook Computer Light ($39.98) illuminates the entire keyboard as well as your work. From ASF Associates (Merrick, NY), the light ships with four rechargeable nickel-cadmium batteries, three Ektron bulbs, an adapter/charger, and a soft case.
Phone: (800) 771-3600 or (516) 868-3638.
Circle 1282 on Inquiry Card.

HAND-HELD CONTROL

The SM-3 Hawk ($299) provides mouse emulation from up to 40 feet away from your computer or LCD panel. The Laserex (Scottsdale, AZ) infrared device has a plate that allows 360 degrees of cursor control, and it lets you select menu items, perform click-and-drag operations, and open and close files.

Phone: (800) 225-5503 or (602) 951-6969.
Circle 1285 on Inquiry Card.

GRAB A FRAME

Imascan/Mono ($1095), from Imagraph (Chelmsford, MA), provides real-time video-in-window display and frame capture of RS-170 and nonstandard composite video formats. For the PCI bus or VL-Bus, the card supports 8-bit gray-scale display and capture at resolutions as high as 1280 by 1024 pixels. A shared frame buffer provides access to captured data under either DOS or Windows.
Phone: (508) 256-4624.
Circle 1281 on Inquiry Card.

DUAL-CHANNEL I/O

The DSP-100 ($249), a dual-channel RS-232 asynchronous serial adapter PCMCIA card, is compliant with the PC Card Specification 2.1. The card plugs into a PCMCIA Type II socket and implements its two serial ports via 16550 UARTs. You can select the I/O address space at which the DSP-100 is to be located. The card is from Quatech (Akron, OH).
Phone: (216) 434-3154.
Circle 1295 on Inquiry Card.

PORTABLE HARD DRIVE ▼

An 11-ounce, pocket-size portable hard drive with a capacity of 170 to 810 MB, the Plugger (from $499) connects to any parallel printer port on DOS and OS/2 systems. From Computer Connections America (Bedford, MA), the drive has an access time of 12 ms and supports Stacker and DoubleSpace. The Plugger is also EPP compliant and has a printer pass-through, keyboard and mouse power adapters, and an AC wall plug.
Phone: (800) 438-5336 or (617) 271-0444.
Circle 1283 on Inquiry Card.

V.34 ACCORDING TO ITU

The V.34-based Bullet 100E external fax/modem features a menu-driven LCD panel that displays line conditions and throughput speeds. In conjunction with SmartKeys, the panel lets you easily set and change your modem configurations. As part of its compliance with the ITU V.34 specification, the Bullet 100E is capable of four-dimensional trellis coding. The modem is backward compatible with V.32terbo and lower modems and operates at all conventional line speeds from 300 bps up to 28.8 Kbps. Additionally, it supports two-wire leased lines with auto-dial backup and line restoration and has built-in flash ROM. The Bullet 100E costs $499.

Contact: E-Tech Research, Santa Clara, CA, (800) 328-5538 or (408) 988-8108.
Circle 1272 on Inquiry Card.

EASY ANNOTATIONS

The Electronic Marker Pad ($295), from Consumer Technology Northwest (Beaverton, OR), lets you make real-time annotations to computer presentations produced with any Windows or Mac application. You can enter graphical information into your computer using colors, pen widths, and symbols that you can change on the fly. The product, which consists of software and a digitizing tablet and pen, plugs into your computer's serial port and can function as a mouse when the Electronic Marker software is not activated.
Phone: (800) 356-3983 or (503) 643-1662.
Circle 1284 on Inquiry Card.

ALL-IN-ONE STORAGE AND ▼ RETRIEVAL

A complete document-image storage-and-retrieval system for the desktop, The Knowledge Builder ($2995) lets you quickly scan, store, manage, and retrieve documents. From MindWorks (Sunnyvale, CA), the system combines the company's Recollect software with a gray-scale desktop scanner and the MindBank 270 removable magnetic-cartridge storage device. One 270-MB cartridge and a SCSI kit are included.
Phone: (800) 396-6463 or (408) 730-2100.
Circle 1286 on Inquiry Card.

SCSI ON TWO CHANNELS

A VESA-based dual-channel SCSI host adapter, the ABP852 (from $479) supports two 10-MBps SCSI channels. Each channel can have up to seven devices, for a connection capability of 14 peripherals, from a single VESA slot. The adapter is compatible with Windows, Chicago, Windows NT, NetWare, Unix, and OS/2. From AdvanSys (San Jose, CA), the ABP852 can provide data redundancy and mirror data across the two separate SCSI channels.
Phone: (408) 383-9400.
Circle 1290 on Inquiry Card.

What's New Hardware

SOUND UPGRADE

Ensoniq's (Malvern, PA) Soundscape Daughter Board ($129) lets you easily upgrade your 16-bit FM sound card via its 26-pin audio-expansion connector. The board features 16 channels, 32 simultaneous voices, 32-note polyphony, and a 1-MB E-wave patch set.

Phone: (610) 647-3930.

Circle 1294 on Inquiry Card.

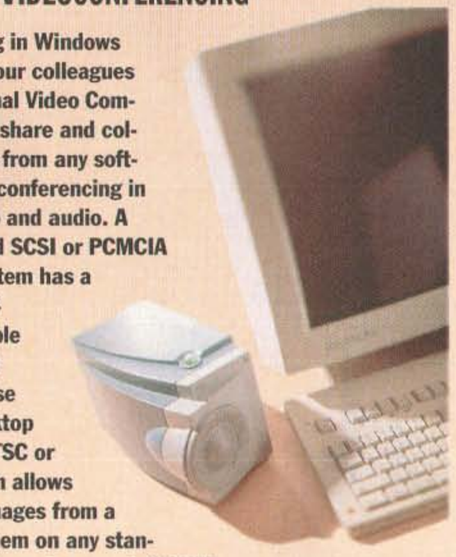
FAXES ON THE COLOR LASERJET

Designed for the Hewlett-Packard Color LaserJet, Extended Systems' (Boise, ID) FaxConnection MFP ($1095) brings PC faxing and plain-paper color fax reception to workgroups. With the device, you can send color fax documents from a PC or receive them directly at the HP Color LaserJet printer. The unit, which slides into the printer's MIO slot, allows all users on a Novell Ethernet network to send color documents created with DOS or Windows applications from their workstations. PocketFaxServer software is included.

Phone: (800) 235-7576 or (208) 322-7575.

Circle 1293 on Inquiry Card.

CROSS-PLATFORM VIDEOCONFERENCING



Whether you're working in Windows or on a Mac, you and your colleagues can use the Eris Personal Video Communications System to share and collaborate on documents from any software application while conferencing in real time with full video and audio. A portable, self-contained SCSI or PCMCIA peripheral, the Eris system has a built-in 28.8-Kbps V.34 modem that's compatible with digital or standard phone lines. You can use the system's color desktop video camera or any NTSC or PAL video device, which allows you to capture video images from a remote site and view them on any standard TV or VCR. The Eris system costs $4995.

Contact: RSI Systems, Edina, MN, (800) 496-4304 or (612) 896-3020.

Circle 1273 on Inquiry Card.

LISTEN TO THIS KEYBOARD ▲

The Maxi Sound multimedia keyboard ($99) from Maxi Switch (Tucson, AZ) features two specially designed speakers and an audio electronics subsystem from Altec Lansing (Milford, PA). The audio subsystem's dynamic circuitry and special acoustic-chamber construction are combined with the keyboard's built-in omnidirectional microphone and a master volume-control slide switch.

Phone: (602) 746-9378.

Circle 1289 on Inquiry Card.

PC IN A TABLET

The Stylistic 500 ($2795) puts a 486DX2/50 CPU in a 2.6-pound tablet that measures 7.2 by 10.7 by 1.5 inches. From Fujitsu Personal Systems (Santa Clara, CA), the tablet PC includes a pair of PCMCIA expansion slots and an infrared serial interface. Its 4 MB of RAM is expandable to 20 MB, and it can support an external VGA monitor. A 105-MB PCMCIA hard drive, DOS 6.2, and Windows for Pen Computing are included with the tablet.

Phone: (800) 831-3183 or (408) 982-9500.

Circle 1292 on Inquiry Card.

MOBILE STORAGE

Able to store as much as 100 GB of data and transfer a 1-MB file in 6 seconds, the 10-ounce Pereos storage product ($695) runs on two AA batteries. From Datasonix (Boulder, CO), the Pereos plugs into the parallel port of your PC and uses a standard Windows interface. The unit includes data management tools, such as Fuzzy Find. Each 1.2-GB cartridge ($28.95) is the size of a postage stamp.

Phone: (800) 328-2779 or (303) 545-9500.

Circle 1296 on Inquiry Card.

MINIATURE HUB ▼

An eight-port palmtop Ethernet hub, the CN8800TPC ($279) from CNet Technology (San Jose, CA) lets you expand your network using 10Base-T cabling. The hub includes two LEDs for each port to indicate link/receive and partition status, and it features a switch-selectable AUI/BNC port for backbone or mixed-media connectivity.

Phone: (800) 486-2638 or (408) 954-8000.

Circle 1291 on Inquiry Card.

ETHERNET SWITCHES

Plaintree Systems' (Waltham, MA) Wave-Switch 100 ($2995) provides connectivity to 100Base-TX and 100VG-AnyLAN standards. The unit includes two option slots, both of which can accept an FDDI, 100Base-TX, 100VG-AnyLAN, or Wave-Bus fast Ethernet interface module. You can install any combination of modules in the unit.

Phone: (800) 370-2724 or (617) 290-5800.

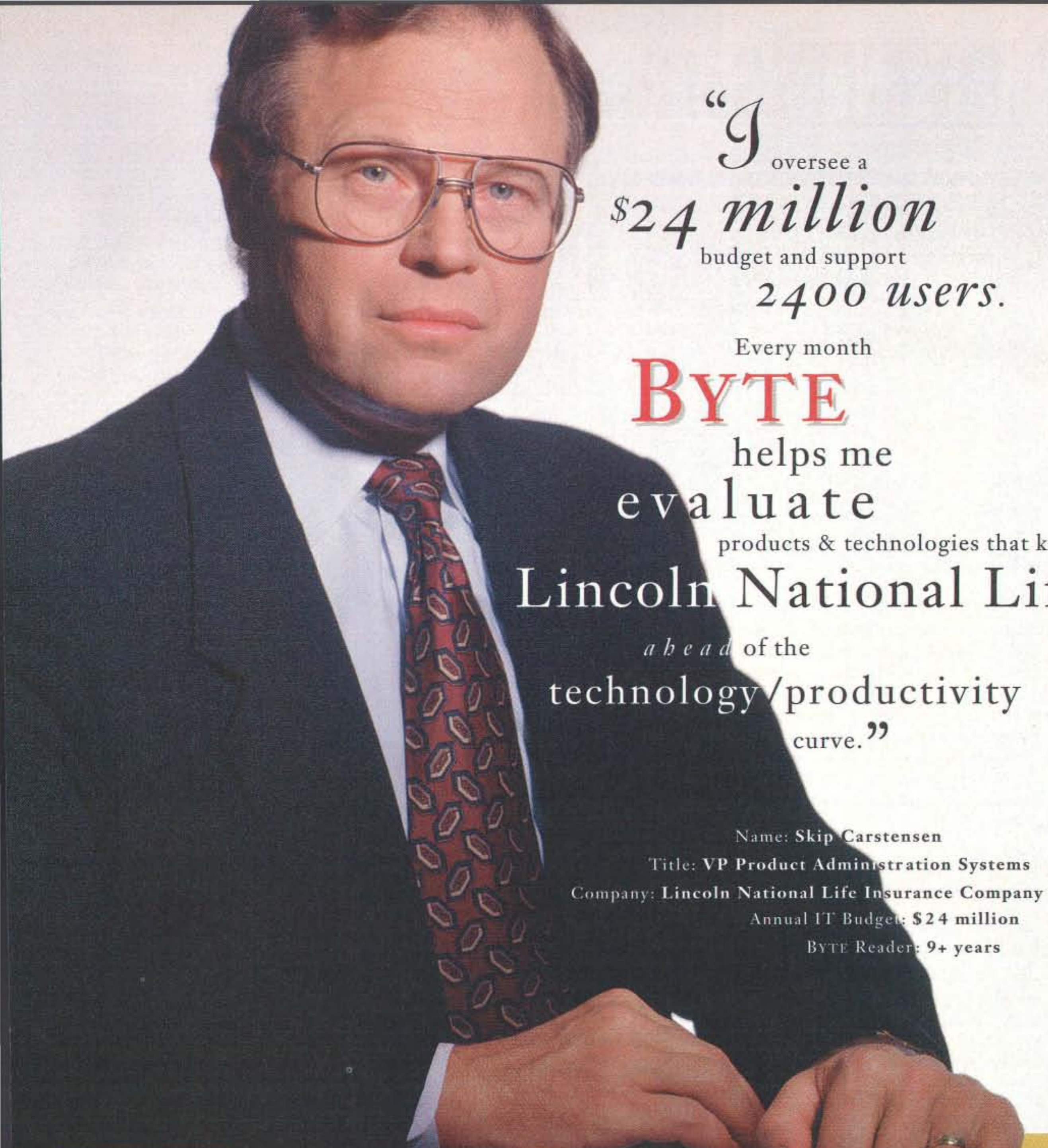
Circle 1287 on Inquiry Card.

GAIN INTERNET ACCESS

ISDN*tek's (San Gregorio, CA) CyberSpace Internet Card ($395) allows you to digitally connect to the Internet or a Unix host while you're running Windows or OS/2 on your PC. The ISDN-compatible card supports a 56- or 64-KB data call on one B channel and includes interface drivers for your Win-ISDN-compatible TCP/IP software to support such applications as Mosaic and Gopher. In addition, you can use the card for high-speed data transfers directly between ISDN users or between sites that have HDLC and synchronous PPP hardware and software.

Phone: (415) 712-3000.

Circle 1276 on Inquiry Card.



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Name: **Skip Carstensen**
Title: **VP Product Administration Systems**
Company: **Lincoln National Life Insurance Company**
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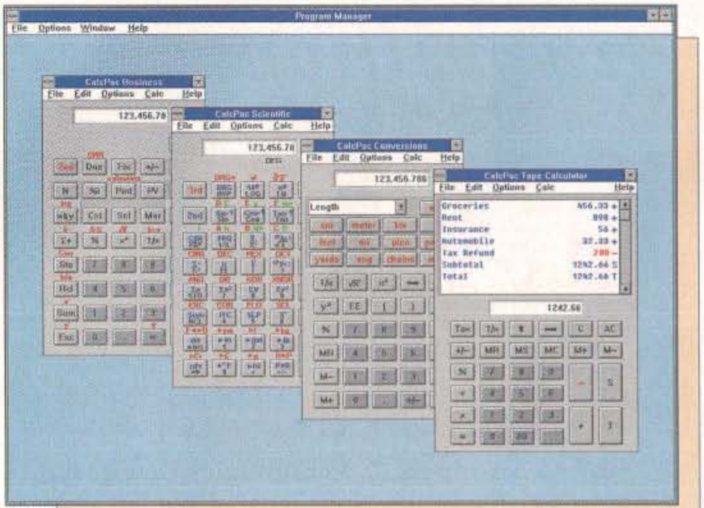
What's New Software



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Rent              898 +
Insurance          56 +
Automobile      32.33 +
Tax Refund        200 -
Subtotal      1242.66 S
Total         1242.66 T
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A WINDOW OF CALCULATIONS

A calculator program for Windows, CalcPac consists of four calculators, each with a specific function. CalcPac Business emulates Texas Instruments' BA-II Executive Business Analyst, while CalcPac Scientific operates like the TI-36X and has more than 160 functions; both are programmable, have tapes, and can generate graphs of data sets and loan payments in multiple presentation styles. CalcPac Conversions can perform more than 2000 conversions from 23 categories; CalcPac Tape operates like a standard desktop adding machine. The cost of the program is $59.95.

Contact: System Essentials, Chesterfield, MO, (800) 335-9733 or (314) 537-9537.

Circle 1298 on Inquiry Card.

DESIGN A GUI

From Annabooks (San Diego, CA), DOS Buttons ($249) lets you design a GUI that works with any pointing device, such as a mouse, touchscreen, or pen. The program creates a real-time environment in which you can embed your specific function routines. You can use the built-in tool sets to create labeled buttons that can either activate functions or bring up windows containing more buttons.

Phone: (800) 462-1042 or (619) 673-0870.

Circle 1302 on Inquiry Card.

PROTECTION FROM PROWLERS

LANWatchMan Prowler Detection System NLM 1.0 (from $299) installs on any LAN file server that lets a LAN administrator configure security watch points. The D&G Infosystems' (Hampstead, NY) software generates an alarm whenever a given watch point detects prowler activity and/or security breaches.

Phone: (516) 538-1240.

Circle 1319 on Inquiry Card.

A BBS FOR UNIX

The Major BBS for Unix (eight-user license, $2995) retains the look and feel of its DOS predecessor in its support for the BSD/386 1.1 and Solaris 2.3 operating systems. The Galacticomm (Fort Lauderdale, FL) software supports TCP/IP; it also has built-in Telnet and integrated FTP. UDAs (user-defined applications) integrate any external text-based applications, such as Oracle databases, spreadsheets, shell accounts, and utilities, as a seamless menu option. A windowing interface enables system administrators to perform maintenance while the system is running over a network.

Phone: (800) 328-1128 or (305) 583-5990.

Circle 1305 on Inquiry Card.

COLOR-MATCHING ACCURACY

SwatchPrinter Software for Windows ($48), from Trumatch (New York, NY), eliminates the guesswork from color matching by letting you exactly match the colors produced by your PostScript-compatible printer. You can print a hard-copy reference guide of more than 2000 color swatches and then use any color you select from within graphics applications from Adobe, Aldus, Corel, Micrografx, and Quark. A Colorfinder fan guide ($20) ensures color accuracy for materials to be printed on a standard four-color press.

Phone: (800) 878-9100 or (212) 302-9100.

Circle 1303 on Inquiry Card.

FRONT-OFFICE SUPPORT

Art*Enterprise for OS/2 ($7995) is an object-oriented development tool for building client/server applications that integrate information contained in databases and on-line documents and that use rules to automate business policies. From Inference (El Segundo, CA), the software lets you develop applications and deploy them without change to both OS/2 and Windows environments, with a native look and feel in each environment.

Phone: (800) 336-9923 or (310) 322-0200.

Circle 1304 on Inquiry Card.

SUPPORT FOR POWERBASIC

The QuickPak Professional add-on library for PowerBASIC ($199) contains nearly 600 subroutines and functions. From Crescent Software (Ridgefield, CT), the library provides low- and high-level services to help with tasks that BASIC cannot do directly, are difficult to carry out, or are time-consuming to program.

Phone: (800) 352-2742 or (203) 438-5300.

Circle 1306 on Inquiry Card.

ANTIVIRUS TRANSFER

A file transfer utility, Mobile Protect ($79) from Trend Micro Devices (Torrance, CA) provides antivirus protection for IBM-compatible notebooks and laptops. Able to detect and destroy all virus types—including Mutation Engined viruses—during data transfers, the utility has a synchronization option that simultaneously copies files between systems; a file-updating option automatically copies only the newest files.

Phone: (310) 782-8190.

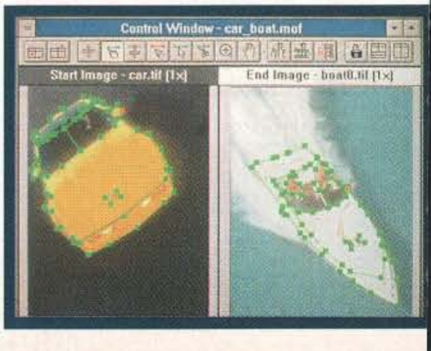
Circle 1325 on Inquiry Card.

OLE-COMPATIBLE MORPHING ▼

An intuitive, full-featured morphing and special-effects-creation tool, MorphStudio ($59) lets you morph images together to produce single-frame effects or video sequences. Special-effects filters include warping, whirlpool, and wind; advanced options let you append multiple morph and special-effects sequences together. You can add your completed sequences to any OLE-compatible program, such as PowerPoint or Harvard Graphics. MorphStudio is from Ulead Systems (Torrance, CA).

Phone: (800) 858-5323 or (310) 523-9393.

Circle 1307 on Inquiry Card.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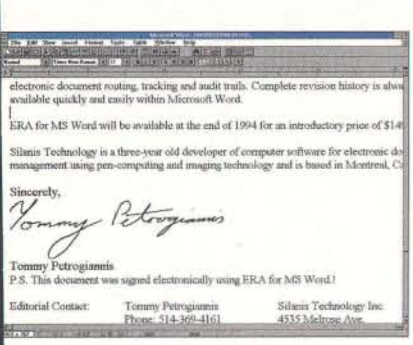


electronic document routing, tracking and audit trails. Complete revision history is alw
available quickly and easily within Microsoft Word.

ERA for MS Word will be available at the end of 1994 for an introductory price of $14

Silanis Technology is a three-year old developer of computer software for electronic do
management using pen-computing and imaging technology and is based in Montreal, C

Sincerely,

Tommy Petrogiannis

Tommy Petrogiannis
P.S. This document was signed electronically using ERA for MS Word.!

Editorial Contact:	Tommy Petrogiannis Phone: 514-369-4161	Silanis Technology Inc. 4535 Melrose Ave.

ELECTRONIC DOCUMENT APPROVAL ▲

ERA (Electronic Revision and Approval) for Microsoft Word ($149) lets you electronically approve any Word document by signing your name using a normal ballpoint pen and a pressure-sensitive signature pad. From Silanis Technology (Montreal, Quebec, Canada), ERA provides the electronic signature as a visual clue to let oth-ers know that a drawing was approved. AutoCAD, however, does not make the signature part of the drawing, eliminating the threat of someone's copying or altering the signature. ERA can verify a document's integrity by ensuring that it has not changed since a previous approval. Encrypted copy protection shields the signature from tampering.

Phone: (514) 369-4161.

Circle 1308 on Inquiry Card.

OS/2 NETWORKS WITH WINDOWS

A 32-bit OS/2 peer-to-peer network operating system, LANtastic for OS/2 (from $139) lets you easily integrate OS/2 systems into your existing DOS and Windows networks. With the Artisoft (Tucson, AZ) system, you can connect to key SMB-based network operating-system servers, including those from IBM and Microsoft. The software also coexists with NetWare 3 and 4 and LAN Server network client software on the same machine.

Phone: (800) 233-5564 or (602) 670-7100.

Circle 1309 on Inquiry Card.

VIDEO CONTROL WITH OLE

An integration package that supports OLE 2.0, Video Control 1.0 ($99) provides the power to capture, edit, and play back video clips in a single Windows application. From Stefra (Milpitas, CA), Video Control features dynamic configuration of the user interface to control VCRs and video laserdisc players through a serial link, as well as video-clip capture, linking and embedding of video clips in documents, drag-and-drop operations, video editing on a single slide bar, and single-frame capture to graphics formats.

Phone: (408) 263-2730.

Circle 1313 on Inquiry Card.

A VERSATILE BOOT UTILITY

Modular Software Systems' (Kent, WA) Wizard of O.S. ($99) lets you choose whether to boot your PC using DOS, OS/2, Windows 95, Windows NT, or Unix. You can have multiple versions of DOS or OS/2, as well as different configurations of a particular operating system. You can also install multiple operating systems on the same hard disk.

Phone: (800) 438-3930 or (206) 631-5781.

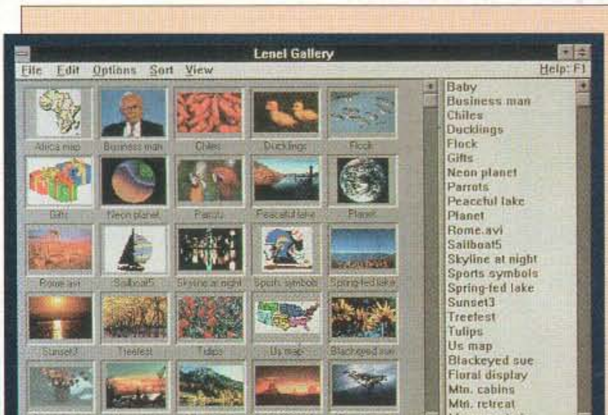
Circle 1310 on Inquiry Card.

SERVE UP WINDOWS NT

NFSware 1.0 for Windows NT (from $295) provides the ability to easily export multiple file systems from an NT system. The 32-bit, multithreaded NFS server, from Process Software (Framingham, MA), permits a user who is running a Unix, Windows for Workgroups, or other TCP/IP-based system to mount that file system from a local system.

Phone: (800) 722-7770 or (508) 879-6994.

Circle 1312 on Inquiry Card.



THUMBNAIL POWER

With OLE drag and drop, the Lenel Gallery GUI for Windows is compatible with virtually any Windows development environment that supports OLE Controls, OLE 2.0 Automation, VBXes, and DLLs. The tool lets you integrate graphical thumbnail galleries, menus, and toolbars directly into your applications. You can create thumbnails for any file, resize them, and link each one with any information you specify. You can display the corresponding file in its entirety with an associated supporting application. The Lenel Gallery costs $299.

Contact: Lenel Systems International, Fairport, NY, (716) 248-9720.

Circle 1299 on Inquiry Card.

Software Update

Adobe Premiere 4.0 for Windows, Adobe Systems (Mountain View, CA), adds frame-accurate device control; batch capture and processing; Edit Decision Lists; titling; motion control; enhanced previewing; multiple audio and video tracks; and custom filters, transitions, and keys. $495 (introductory price, good through February 15).

Phone: (800) 833-6687 or (415) 961-4400.

Circle 1326 on Inquiry Card.

d-Time 1.1, Ballard Synergy (Silverdale, WA), includes a Windows help program with full-motion video; quick install; support for enhanced IDE hard drives, Novell DOS 7, and 4DOS; automatic Timelog search for the current CD-ROM; and additional Timelogs for recent titles. $69.95.

Phone: (206) 656-8070.

Circle 1327 on Inquiry Card.

Common Ground 2.0, No Hands Software (Belmont, CA), adds resolution-independent fonts, transparent PostScript support, antialiasing of text, OLE 2.0 automation, E-mail integration, automated conversion of multiple documents, bookmarks and highlighting, a Verity search engine, a split view, an updated MiniViewer, and integrated text compression. $189.95.

Phone: (800) 598-3821 or (415) 802-5800.

Circle 1328 on Inquiry Card.

Mathematica 2.2, Wolfram Research (Champaign, IL), is available in a native OS/2 version that takes full advantage of the OS/2 preemptive scheduler and threading; it's compatible with OS/2 Warp 3.0. $995.

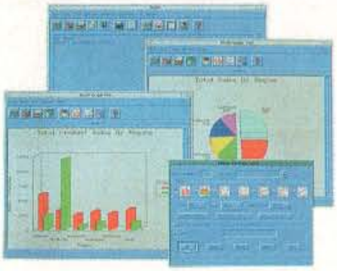
Phone: (800) 441-6284 or (217) 398-0700.

Circle 1338 on Inquiry Card.

What's New Software

OSF/MOTIF FOR STATISTICS

Statware's (Corvallis, OR) Statit statistical and graphical analysis software is now available in an OSF/Motif version (from $895). Features of the user interface include the ability to display multiple graphics windows (so you can see different views of a data set), continual access to all graphs produced during a work session, a spreadsheet-style window, online hypertext help, pull-down menus, and user-configurable smart buttons.



Phone: (503) 753-5382.

Circle 1311 on Inquiry Card.

COLOR MANAGEMENT

Pantone ColorDrive ($199), from Pantone (Carlstadt, NJ), lets you use your desktop system to standardize color palettes and output calibrated colors across major design and illustration applications. This application-independent color-palette management software functions as a central clearinghouse for desktop color data and allows you to select calibrated Pantone color systems and custom colors. You can also import colors previously produced within other programs and export them for use in other applications.

Phone: (201) 935-5500.

Circle 1315 on Inquiry Card.

HELP FOR FINANCIAL DECISION MAKING

Comprising four integrated modules, The Financial ToolKit ($195) helps you make critical financial decisions. From MoneySoft (Phoenix, AZ), the toolkit guides you in analyzing the performance and value of your company and helps you determine how the decisions that you make today can ultimately impact the future financial position of your company.

Phone: (800) 966-7797 or (602) 266-7710.

Circle 1316 on Inquiry Card.

PROJECT MANAGEMENT

A cross-platform application for planning and managing projects, Plan & Track for Windows ($295) includes integrated spreadsheet, graphing, and earned-value features that you use to relate resource and financial data to project tasks and analyze overall project status. From Mainstay (Camarillo, CA), the Gantt-chart-based software can link multiple charts together for hierarchical organization, connecting a job bar on an upper-level chart to an entire lower-level chart. File-level compatibility exists between the Mac and Windows versions.

Phone: (805) 484-9400.

Circle 1317 on Inquiry Card.

SHADOW YOUR FILES

Available for SPARC platforms running SunOS 4.1.x or Solaris 2.x, ZShadow (from $695) takes periodic snapshots of your workstation's file system, providing easy access to a chronological history of your files. From Zzyzx (San Diego, CA), the file-system-shadowing software maintains multiple versions of a file, automatically saving them at predetermined intervals. Since only the differences among versions are captured, minimal disk space is required.

Phone: (619) 558-7800.

Circle 1318 on Inquiry Card.

Software Update

Download Mechanic 1.5, Acquired Knowledge (San Diego, CA), features the ability to generate and print laser proofs, print imagesetter pages in transverse orientation, and add to an existing queue of PostScript files while the queue is being downloaded; an improved ability to automatically download missing fonts; improved PostScript file analysis; and a Windows version. $249.

Phone: (619) 587-4668.

Circle 1329 on Inquiry Card.

CD Connection 3.1, CBIS (Norcross, GA), adds a Windows interface, transparent disk mirroring, increased CD-ROM-sharing speed and performance, ASPI compliance, easy-to-use installation and configuration, and faster performance-caching algorithms. From $395.

Phone: (800) 344-8426 or (404) 446-1332.

Circle 1330 on Inquiry Card.

KwikStat 4, TexaSoft (Cedar Hill, TX), adds SmartPoint and supports unbalanced, two-way, analysis-of-variance designs; Pareto charts; Kaplan-Meier Survival Analysis; Dunnett, Tukey, and Scheffé multiple comparisons; numerous comparison-chart types; and a 3-D spin plot. Basic edition, $99.

Phone: (800) 955-8392 or (214) 291-3151.

Circle 1331 on Inquiry Card.

MediaDeveloper 2.0, Lenel Systems International (Fairport, NY), adds support for OLE 2.0 Controls. $695.

Phone: (800) 225-3635 or (716) 248-9720.

Circle 1337 on Inquiry Card.

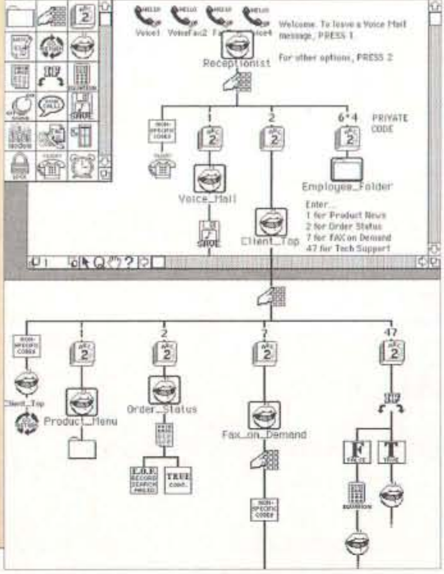
MACS GIVE A VOICE TO PCS

A multiline phoneware system, Duet lets you use a Mac to create sophisticated commercial-grade telephony applications. The $750 package combines Magnum Software's (Chatsworth, CA) TFLX Picture Programming language for the Mac with Ram Research's DAX software, which runs on most multiline PC platforms.

You create your telephony application, such as voice mail, fax on demand, or interactive voice response, on your Mac by writing a script using the iconic programming tools in TFLX. The script, which controls the DAX software on a PC, is then transferred to the PC via an aid such as Apple's PC Exchange. The PC becomes a slave peripheral to the Mac and can handle up to 128 phone lines. The Mac is returned to everyday use but remains ready for making revisions or additions to the script.

Contact: Ram Research, Concord, CA, (510) 603-1122.

Circle 1300 on Inquiry Card.



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For other options, PRESS 2

Enter...
1 for Product News
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47 for Tech Support

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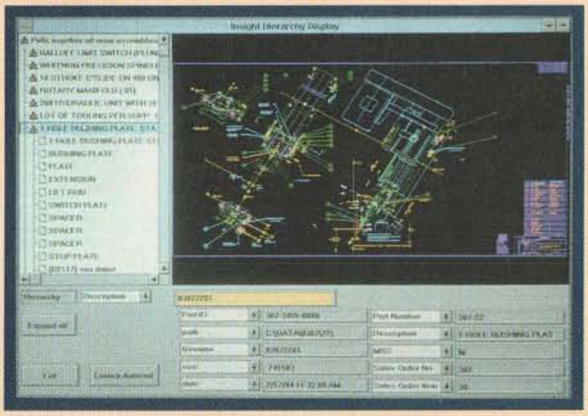

A modular data management software package for design data, Insight lets you build your design-document database from information that exists on your network. You can search the database in different ways for existing designs that meet specific criteria and view high-quality vector images of the designs in a matter of seconds, according to the developer, Process Automation Software and Services. You can peruse hierarchical representations of assemblies and subassemblies, access component parts, view graphical and textual part-classification hierarchies, and access plotters to print CAD drawings and other images. The basic Insight module costs $4950; other modules cost $495 each.

Contact: Process Automation Software and Services, Ann Arbor, MI, (313) 668-6611.

Circle 1301 on Inquiry Card.

HELP AUTHORING FOR UNIX

ForeHelp for Unix ($495) allows you to create your WinHelp and HyperHelp files on Windows or Unix platforms. The Bristol Technology (Ridgefield, CT) help-authoring editor features a test mode, a WYSIWYG editing environment, and graphical displays of hot spots and browse relationships among topics.

Phone: (203) 438-6969.

Circle 1314 on Inquiry Card.

SERVER-BASED INTERNET ACCESS

Nov*ix Elite for Internet (five-user license, $1250) is designed to provide NetWare users with direct access to the TCP/IP-based Internet without the need for additional server or client hardware. The Firefox (San Jose, CA) connectivity system has the components necessary for Internet access and provides centralized management, ICS (Internet Connect Security), support for popular Internet applications, and configuration flexibility.

Phone: (800) 230-6090 or (408) 321-8344.

Circle 1320 on Inquiry Card.

OFFICE SYNERGY

Designed to work, look, and feel like Microsoft Office applications, ProdeaSynergy for Microsoft Office ($99) lets you automate similar or repetitive tasks involving Office applications without using macro or programming languages. The Prodea Software (Eden Prairie, MN) package provides seamless interactions with all Office and Office Professional applications. It also provides an easy upgrade path for including non-Office applications in your automated processes.

Phone: (612) 942-1000.

Circle 1322 on Inquiry Card.

MEETING MANAGER

CalScan, a groupware meeting manager for Windows (from $36 per user), gives you the capability to plan for the short term, provide scheduling for groups and individuals, resolve meeting conflicts, and schedule recurring events. From RBC (Arlington, VA), the cross-platform scheduling software supports Ethernet, LocalTalk, and PhoneNet PC.

Phone: (703) 243-9550.

Circle 1323 on Inquiry Card.

FAX FEATURES FOR UNIX

Designed to support SCO Unix and Interactive Unix, the GammaFax Developers Kit for Unix ($495) provides the software and utilities needed to support the use of GammaLink fax boards for Unix-based fax applications. The software, from GammaLink (Sunnyvale, CA), supports T.434 binary file transfers and includes the company's T.30 software protocol. Applications include fax on demand, file on demand, fax broadcasting, and computer telephony integration.

Phone: (408) 744-1400.

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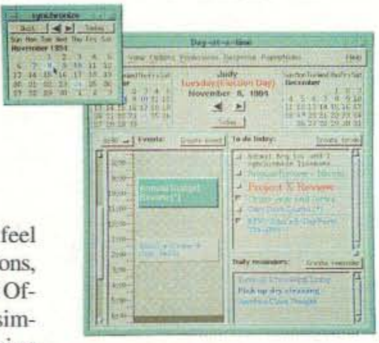


WINDOWS NT SERVER ▲

CrossWind Technologies' (Felton, CA) Synchronize ($100 per user) adds server support for Windows NT. The enterprise-wide scheduling and task management tool can communicate directly across TCP/IP to provide a fast response time and networking across LANs and WANs.

Phone: (408) 335-4988.

Circle 1321 on Inquiry Card.

Software Update

DeskMan/2 1.51, Development Technologies (Forest Acres, SC), offers an enhanced command-line interface, increased speed, a revised user interface for easier installation, reduced memory consumption, and new options for restoring the Workplace Shell to its original configuration. $79.95.

Phone: (803) 790-9230.

Circle 1333 on Inquiry Card.

ImageBASIC 2.0, Diamond Head Software (Honolulu, HI), provides support for dBase for Windows, forms processing, color scanning and display, and image annotation. From $1750.

Phone: (808) 545-2377.

Circle 1334 on Inquiry Card.

FuziCalc 1.5, FuziWare (Knoxville, TN), includes a color presentation-graphics suite, improved DDE capabilities, more than 50 new functions, all-new documentation and on-line help, and more than 25 shortcut keys and convenience features. $495.

Phone: (615) 588-4144.

Circle 1335 on Inquiry Card.

TSSnet for Macintosh 2.6.1, Thursby Software Systems (Arlington, TX), supports the Power Macintosh and System 7.5 and includes a virtual disk capability that enables you to access a remote file on a DECnet network as if it were a local disk. $295.

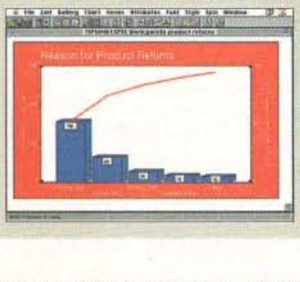
Phone: (817) 478-5070.

Circle 1336 on Inquiry Card.

SPSS 6.1 for the Macintosh, SPSS (Chicago, IL), adds a Mac-style user interface, integrated graphics, more statistics, and Mac-specific features. From $695.

Phone: (312) 329-2400.

Circle 1332 on Inquiry Card.



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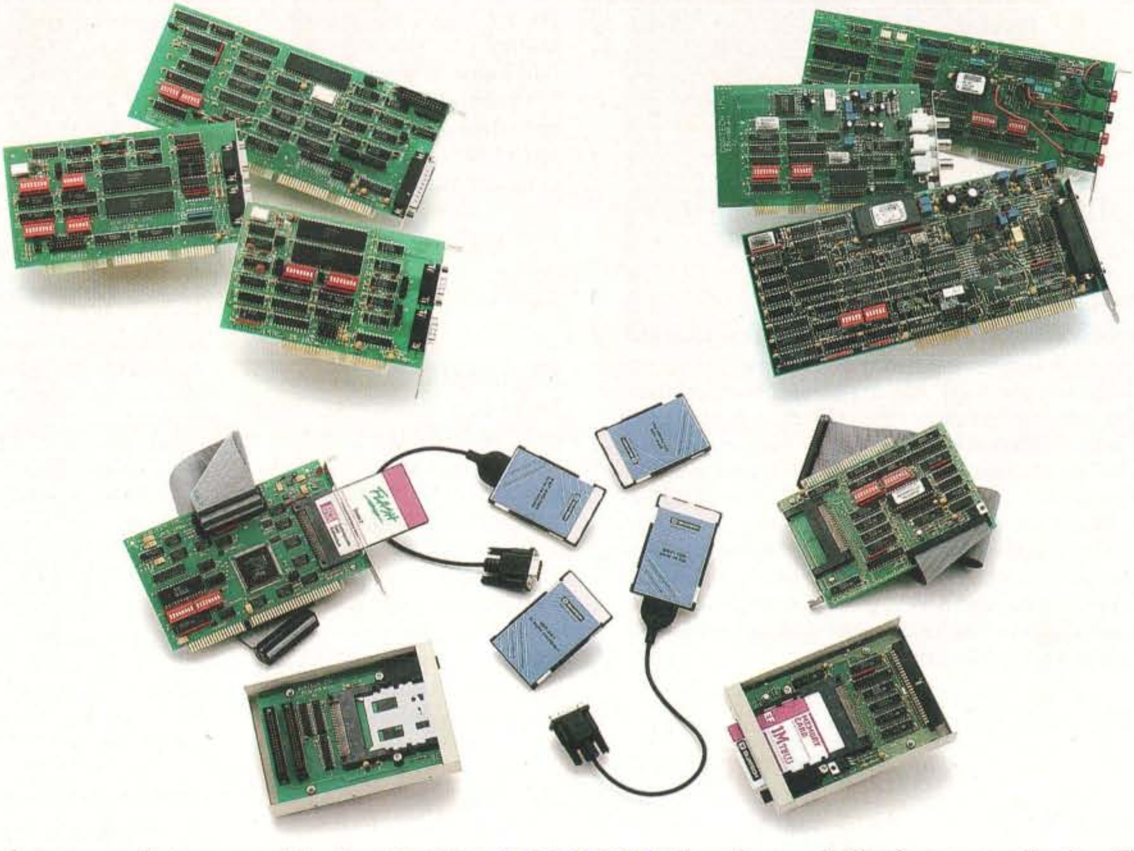

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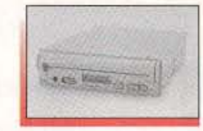

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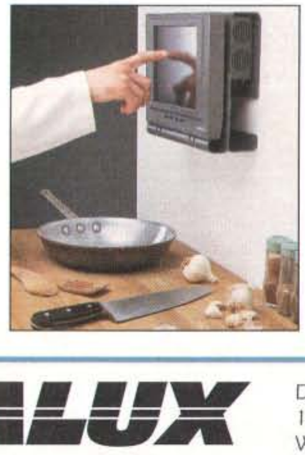

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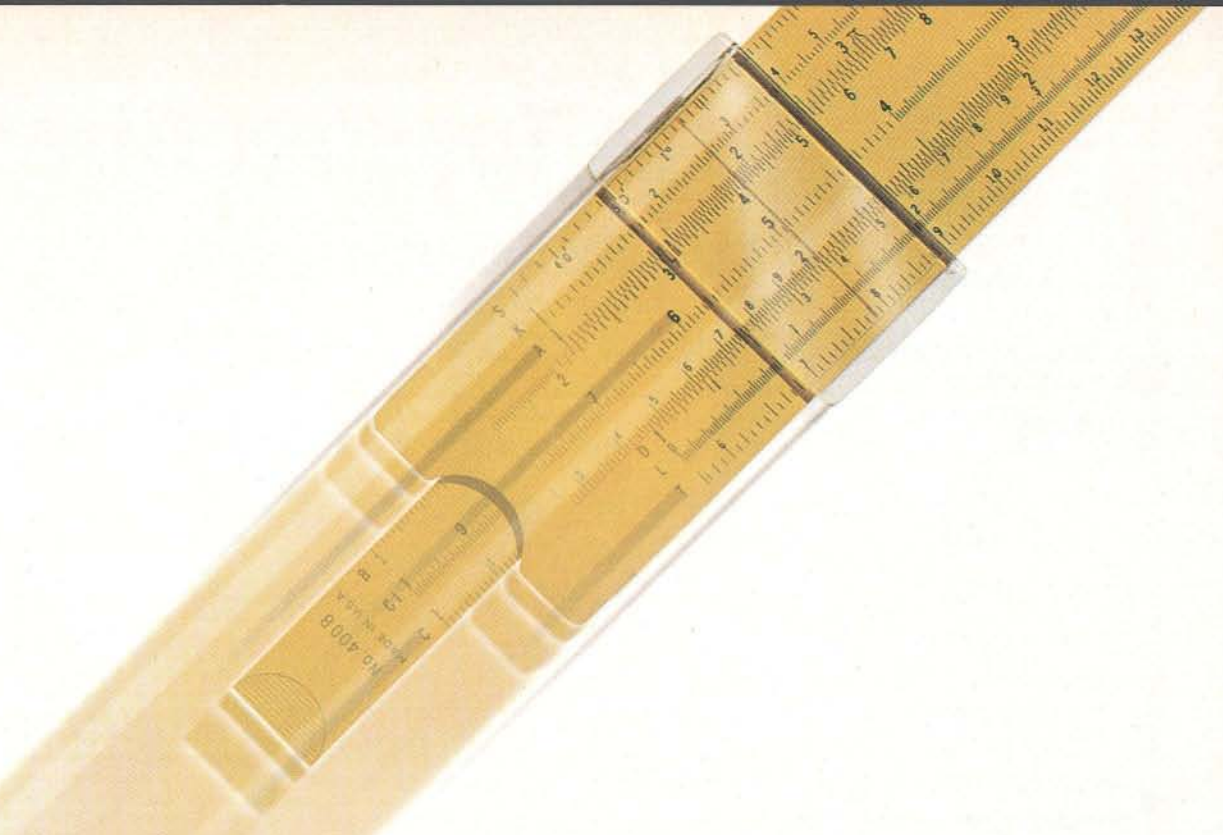

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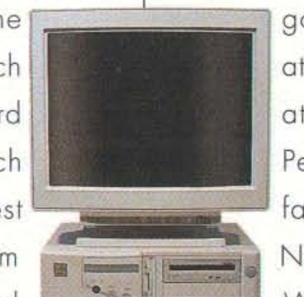

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Versa M

NEW!

- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Removable hard drive and floppy drive
- ▲ Removable screen
- ▲ Integrated speaker, microphone
- ▲ MS-DOS, Windows 3.1, Windows Sound System, Video for Windows Run Time

as low as **$3739**

Processor	Hard Drive	Screen	Price
486DX4/75	250MB	Dual Scan	$3739
486DX4/75	540MB	Active	$5199
486DX4/100	810MB	Active	$6049
486DX4/75	540MB	Enhanced Active	$5579
486DX4/100	810MB	Enhanced Active	$6429
486DX4/75	340MB	True Color Active	$5099

Lease for as low as $91/mo.

Versa V

as low as **$2499**

- ▲ 4MB expandable to 20MB
- ▲ 2 Type II PCMCIA slots or 1 Type III
- ▲ MS-DOS 6.21, Windows 3.1, built-in trackball
- ▲ Removable floppy – add second battery

Processor	Screen	Hard Drive	Price
486DX2/50	9.5" Dual Scan	250MB	$2499
486DX2/50	9.5" Dual Scan	340MB	$2669
486DX2/50	9.5" Active	250MB	$3249
486DX2/50	9.5" Active	340MB	$3399
486DX2/50	9.5" Active	540MB	$3779
486DX4/75	9.5" Active	340MB	$3879
486DX4/75	9.5" Active	540MB	$4249

Lease for as low as $71/mo.

Versa S

as low as **$1699**

- ▲ Upgradable hard drive
- ▲ SurePoint integrated pointing device
- ▲ 2 Type II PCMCIA slots or 1 Type III
- ▲ Only 4.5 lbs.

Processor	Screen	Hard Drive	Price
486SX/33	9.5" Mono	210MB	$1699
486SX/33	9.5" Dual Scan	210MB	$1889
486SX/33	9.5" Active	210MB	$2839
486DX2/50	9.5" Active	260MB	$3299
486DX2/50	9.5" Active	350MB	$3499

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AST

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Ascentia 900N

- ▲ 486DX2/50 or 486DX4/75 processor
- ▲ 4MB/8MB RAM exp. to 32MB
- ▲ 2 Type II or 1 Type III PCMCIA slots

Model	Screen	Hard Drive	Price
4/50 Model 343W	10.3" Dual Scan	340MB	$2719
4/50 Model 343W	9.5" Active	340MB	$4149
4/75 Model 343W	10.3" Dual Scan	340MB	$3219
4/75 Model 513W	10.4" Active	510MB	$5029

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10.4" Active Matrix screen
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NEW!

Ascentia 900N

Ascentia 800N

- ▲ 486SX/33 or DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 9.5" Dual scan color display
- ▲ 2 Type II or 1 Type III PCMCIA slots

Model	Hard Drive	Price
4/33s Model 253W	250MB	$2099
4/33s Model 343W	340MB	$2199
4/50d Model 253W	250MB	$2349
4/50d Model 343W	340MB	$2499

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TravelMate 4000E Color

Processor	Screen	Hard Drive	Price
486SX/25	8.2" Enhanced Color	120MB	$1699
486DX2/40	8.2" Enhanced Color	200MB	$2069
486DX2/50	9.4" Dual Scan	200MB	$2319
486DX2/50	8.4" Active	200MB	$2819
486DX4/75	8.4" Active	340MB	$3549
486DX4/75	8.4" Active	455MB	$3599
486DX4/75	9.5" Active	455MB	$3799

TravelMate 4000M

- ▲ Brilliant color display
- ▲ 16-bit sound card
- ▲ Integrated Pointing device
- ▲ 2 Type II or 1 Type III PCMCIA slot

as low as **$1879**

Processor	Screen	Hard Drive	Price
486SX/25	8.2" Enhanced Color	120MB	$1879
486SX2/50	9.5" Dual Scan	200MB	$2759
486SX2/50	8.4" Active	340MB	$3099
486DX2/50	9.5" Dual Scan	340MB	$3049
486DX2/50	8.4" Active	455MB	$3649
486DX4/75	9.5" Dual Scan	455MB	$3999
486DX4/75	8.4" Active	340MB	$4889
486DX4/100	9.5" Active	525MB	$5549

TravelMate 4000M
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Mobile Computing

TM 4000M

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- ▲ 4/8MB RAM exp. to 20/24MB
- ▲ Built-in AC adapter
- ▲ Removable hard drive
- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Integrated trackball
- ▲ MS-DOS 6.2, Windows 3.1, MS Video for Windows Run Time

Processor	Display	Hard Drive	Price
486DX2/40	9.5" Dual Scan	170MB	$3119
486DX2/40	8.4" Active	170MB	$3779
486DX2/40	8.4" Active	340MB	$4159
486DX2/50	9.5" Mono	250MB	$3299
486DX2/50	9.5" Active	340MB	$4999
486DX4/75	9.5" Active	340MB	$5669
486DX4/75	9.5" Active	510MB	$6139

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LTE ELite

Contura 400

- ▲ 486DX2/40 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Large built-in trackball
- ▲ MS-DOS, Windows 3.1, Tabworks, Lotus Organizer

Display	Hard Drive	Price
9.5" Dual Scan	250MB	$2459
8.4" Active	250MB	$3119

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ThinkPad® 510 subnotebook

- ▲ IBM 486BL2/50 processor
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- ▲ 200MB hard drive
- ▲ 7.7" color display
- ▲ Type II PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive
- ▲ Weighs only 4.0 lbs.
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0

$1699

ThinkPad 360E Notebooks

NEW!

- ▲ 486DX2/50 processor

Screen	Hard Drive	Price
9.5" Dual Scan	340MB	$2889
9.5" Dual Scan	540MB	$3259
8.4" Active	340MB	$3589
8.4" Active	540MB	$3969

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ThinkPad 360® notebooks

- ▲ 486SL/33 processor
- ▲ 4MB RAM exp. to 20MB
- ▲ Modular design, removable hard drive & floppy drive
- ▲ Local Bus Graphics with 1MB video RAM
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0
- ▲ Port Replicator and Docking Station available

Screen	Hard Drive	Price
9.5" Mono	170MB	$1839
9.5" Mono	340MB	$2229
9.5" Dual Scan	170MB	$2199
9.5" Dual Scan	340MB	$2659
8.4" Active	170MB	$2699
8.4" Active	340MB	$3099

ThinkPad 360

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MODEL	SIZE	SPEED	TYPE	PRICE
ST3290A	260MB	15MS	IDE 3.5"	$198
ST3391A	340MB	12MS	IDE 3.5"	$218
ST3491A	420MB	12MS	IDE 3.5"	$234
ST3655A	545MB	12MS	IDE 3.5"	$318
ST3600N	525MB	10MS	SCSI-2	$478
ST31200N	1050MB	10MS	SCSI	$668
ST12550N	2100MB	9MS	SCSI	$1598

CONNER

MODEL	SIZE	SPEED	TYPE	PRICE
CFA210A	210MB	15MS	IDE	$178
CFA340A	340MB	12MS	IDE	$218
CFA420A	420MB	12MS	IDE	$228
CFA540A	540MB	12MS	IDE	$268
CFA810	810MB	12MS	IDE	$498
CFA1060A/S	**1060MB**	**10MS**	IDE/SCSI	**$568**

Maxtor

7290	290MB	15MS	IDE	$178
7345A	345MB	14MS	IDE	$202
7405A	405MB	14MS	IDE	$228
7546A	549MB	12MS	IDE	$308

WESTERN DIGITAL

1210	212MB	13MS	3.5" IDE	$174
2340	340MB	12MS	3.5" IDE	$198
2420	**425MB**	**12MS**	**3.5"IDE**	**$218**
2540	**540MB**	**12MS**	**3.5"IDE**	**$304**

Quantum

LPS270A/S	270MB	12MS	IDE/SCSI	$238
LP340A/S	340MB	12MS	IDE/SCSI	$278
LPS540A/S	540MB	12MS	IDE/SCSI	$298
LPS1080A/S	1050MB	9MS	IDE/SCSI	$718
LPS1225	1200MB	10MS	SCSI	$878

MICROPOLIS

MODEL	SIZE	SPEED	TYPE	PRICE
MC4110S	1050MB	8.5MS	SCSI/IDE	$628
MC2210AV	1050MB	10MS	SCSI	$768
MC2217A	1626MB	10MS	SCSI	$898
MC2217AV	1690MB	10MS	SCSI	$978
MC2217S	1750MB	10MS	SCSI	$908
MC1926	2100MB	11MS	SCSI	$1378
MC1936	3000MB	11MS	SCSI	$1968
MC1936AV	3000MB	10MS	SCSI	$2018
MC1991	9100MB	10MS	SCSI	$3998

CLOSEOUTS

Case Power Suppy (180W)	$29
IBM PS2 1200 Modem	$7
Wordstar 2000	$88
Toshiba Laptop Modem	$19
Mono Card Text Only	$4
NEC Cut Sheet Feeder	$19
Everex 0-10 Meg for AT	$49
Wangtec (5099) 60MB	$98
FastTrax	$9
Lotus Metro	$9

COPROCESSORS

intel

80386 MACHINES:

80387-16MHz	$38
80387-20MHz	$44
80387-25MHz	$59
80387-33MHz	$69
80387DX	$74
80387-SX16	$38
80387-SX20	$48
80387-SX33	$64
80387SL	$79

8088 MACHINES:

8087-3 5MHz	$38
8087-2 8MHz	$44
8087-1 10MHz	$78

80286 MACHINES:

80287-6MHz	$19
80287-8MHz	$24
80287-10MHz	$49
80287-XL	$48
80287-XLT	$78

Cyrix

83D87-33MHZ	$19
83D87-40MHZ	$48
83S87-25MHZ (SX)	$39
83S87-33MHZ (SX)	$44

CPU'S

intel

80486 SX/25	$78
80486 SX/33	$98
80486 DX/25	$138
80486 DX/33	$158
80486 DX/50	$298
80486 DX2/50	$188
80486 DX-2/66	$218
80486 DX4/75	$518
80486 DX4/100	$548
PENTIUM 60	$468
PENTIUM 66	$574
PENTIUM 90	$698

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Cx486DRx²-16/32	$238
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Cx486DRx²-33/66	$358
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286 (6-16 MHZ)	(IBM 486SLC2-50MHZ)	$238
386SX-16 &20 (X2)	(TISXLC2-20/40 MHZ)	$198
386SX-25 MHZ (X2)	(IBM-SLC2-25/50 MHZ)	$318
386SX-33 mhz (X2)	(IBM-SLC2-33/66 MHZ)	$358
386DX-16 & 20 (X2)	(TI SXL2-20/40 MHZ)	$248
386DX-25 MHZ (X2)	(TI SXL2-25/50 MHZ)	$298
386DX-33 MHZ (X2)	(IBM B. LIGHTNING-33/66)	$478
386SX-16 MHZ (X3)	(IBM B. LIGHTNING-16/48)	$418
386SX-20 MHZ (X3)	(IBM B. LIGHTNING-20/60)	$458
386SX-25 MHZ (X3)	(IBM B. LIGHTNING-25/75)	$498
386DX-16 & 20 (X3)	(IBM B. LIGHTNING-20/60)	$398
386DX-25 MHZ (X3)	(IBM B. LIGHTNING-25/75)	$478
386DX-33 MHZ (X3)	(IBM B. LIGHTNING-33/99)	$698

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360K 1/2 HT (5-1/4")	$24
1.2 MB 1/2 HT (5-1/4"	$39
720K 1/2 HT (3-1/2")	$19
1.44 (3-1/2")	$39

D-RAM CHIPS

DESCRIPTION	120NS	100NS	80NS	70NS	60NS
64 X 4	$2.25	$2.45	$2.95		
256 X 1	$1.85	$2.40	$3.00	$3.15	$3.20
256 X 4		$5.45	$5.95	$6.45	$6.95
1MEG X 1	$4.40	$4.90	$5.75	$6.45	$6.75
1MEGX4			$26.00	$29.00	$34.00
256X16 VRAM (WE)				$49.00	$59.00
256X16 VRAM (CAS)				$39.00	$49.00

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2-8 MB FOR PS/2 50 & 60,
2MB $119, 4MB $188, 8MB $348

SIMM MODULES

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30 PIN SIMM MODULES

DESCRIPTION	100NS	80NS	70NS	60NS	53NS	40NS
256X9	$9	$12	$15	$17		
1MEGX3		$35	$37	$41	$49	$64
1MEG X 9	$34	$39	$40	$46	$64	$78
4MEG X 9		$129	$134	$148		
16 MEG X 9 (36 CHIP)			$668			

72 PIN SIMM MODULES

512X36 2MEG	$78	$84	$98
1X36 4MEG	$148	$154	$198
2X36 8MEG	$302	$309	$378
4X36 16MEG	$578	$588	$618
8X36 32MEG		$1175	$1275
16X36 64MEG		$2695	$2795

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	12ns	15ns	20ns	25ns
8KX8		4.95	4.45	3.95
32X8	14.00	7.95	6.75	6.55
64x1		10.95	6.05	5.95
64x4		10.00	5.95	4.95
16x4		6.95	5.45	4.95
128x8			34.00	27.00

MEMORIES FOR THE NEW YEAR

IBM PS/2 Memory

MODEL	MEMORY	PART#	PRICE
AMBRA Enterprise 386, Hurdla 386, Sprinta 386 (all models)	2MB	N/A	$93
	8MB	N/A	$328
AMBRA Enterprise 486, Hurdla 486, Sprinta 486 (all models)	4MB	N/A	$178
	16MB	N/A	$648
PS/1 and 386/SX (2121)	2MB	92F9935	$88
	4MB	92F9694	$178
PS/2 30/286;25/286; Adpt Brd 1497259	512K	30F5348	$35
	2MB	30F5360	$88
PS/2 35SX, LS, 40SX, 70-E61; 061; 121, Adpt Brd 6450609; 34F3011; 34F3077, 502, 55SX, 655SX, P70, 55LS, 65LS X Station 120 & 130	1MB	6450603	$39
	2MB	6450604	$84
PS2 50, 50Z, 55SX, 60, 65SX	2-8MB	1497259	$198
	2-16MB	6450609	$368
PS/1 Consultant, Essentials & Expert models x43, x44 & PS/Valuepoint all models except Cxx series	4MB	96F9290	$174
	16MB	96F9291	$598
PS/2 70-A21; A61; B21; B61; PS/1 Consultant, Essential & Expert models x11, x13 & x14, PS/Valuepoint Cxx series	1MB	6450603	$39
	2MB	6450608	$89
PS/2 35SX; LS, 40SX, 55SX; LS, 65SX;	4MB	34F2933	$168
PS/2 90 XP, 95 XP, P75 (Pairs), 56 57 (all) 76, 77, PS/1 Pro 2123	2MB	6450902	$88
PS2 90, 95 XP, P75 (Pairs) 56, 57, (all) PS/1 Consultant, Essential, Expert x11, x13 & x14, PS/1 Pro 2123, RS/6000	4MB	6450128	$174
	8MB	6450130	$338
PS2/2 35SX; LS; 40SX	8MB	6450129	$338
PS2 70's and 80's	2-8MB	6450605	$297
32 BIT BOARDS	2-14MB	34F3077	$225
32 BIT BOARDS	4-16MB	34F3011	$318
PS/2 80-A21; A31; A61	4MB	6451060	$188
PS/2 80-041	1MB	6450375	$78
PS/2 80-111; 311; 121; 321; 081; 161	2MB	6450379	$94

4010RISC/6000(16MB) $768, 4033(32MB) $1598, 4036(64MB) $3298

IBM Laptop Memory

Thinkpad 300, Ambra Treka	2MB	33G9288	$128
	8MB	33G9289	$368
Thinkpad 350, 350C, 360, PS/NOTE	8MB	6060378	$338
	16MB	6060379	$647
Thinkpad 500, 510CS, 2618	4MB	8189098	$198
	8MB	8189099	$388
	16MB		$848
CL57SX	4MB	07G1420	$208
Thinkpad 700, 700C, 720, 720C, 750C	8MB	07G1421	$378
	16MB	6665109	$898
Thinkpad 710T	4MB	N/A	$188
	8MB	N/A	$318
PS/Note N45SL	2MB	92F8804	$108
PS/2, N51, SLC, SX	2MB	07G1826	$98
	4MB	07G1827	$188
	8MB	07G1828	$418
Laptop N33SX, L40SX & PSNOTE 182	2MB	79F0999	$98
	4MB	79F1000	$184
L40SX, PSNOTE 182 ONLY	8MB	79F1001	$358

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MODEL	MEMORY	PART#	PRICE
T1000 SE/LE/XE	1MB	PA8311U	$29
T1000 SE/LE/XE	2MB	PA8312U	$73
T2000 / T2000SX	2MB	PA8317U	$73
T2000SX/T1000LE	4MB	PA8314U	$188
	8MB	PA8315U	$358
T1200 XE	2MB	PA8306U	$98
T1600	2MB	PA8302U	$98
T2000 SXE/T2200SX/T1800 T1850, C	2MB	PA2000U	$78
	4MB	PA2001U	$188
	8MB	PA2002U	$358
T3100	2MB	PA7135E	$138
T3100E	2MB	PA8341U	$108
T3100SX	2MB	PA8308U	$108
	4MB	PA8310U	$188
T3200 SX	2MB	PA8307U	$118
	4MB	PA8309U	$198
T3200 SXC	2MB	PA8318U	$108
	4MB	PA8319U	$198
T3200	3MB	PA7137U	$184
T3300SL	2MB	PA2006U	$118
	4MB	PA2007U	$238
	6MB	PA2008U	$258
	16MB	PA2009U	$698
T3400CT	4MB	PA2019V	$188
	8MB	PA2020V	$368
	16MB	PA2021V	$758
T4400 SX, SXC, T6400 SXC, DXC	2MB	PA2003U	$125
	4MB	PA2004U	$198
	8MB	PA2005U	$358
	16MB	PA2010U	$698
	32MB		$1548
T4500, T4600, T1900C (3.3VOLTS) T4700	4MB	PA2012U	$198
	8MB	PA2013U	$388
	16MB	PA2014U	$758
T5100	2MB	PA8301U	$94
T5200/T5200C/T8500/T5400	2MB	PA8304U	$109
	8MB	PA8313U	$418

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AST Memory

MODEL#	MEMORY	PART#	PRICE
PREMMIA	4MB	501159-001	$168
	8MB	501159-002	$348
	16MB	501159-003	$734
ADVANTAGE 386SX/20;25, PRO SX/25 BRAVO 3/33'S	2MB	500962-001	$88
	8MB	500962-002	$348
BRAVO NB486	4MB		$198
	16MB		$798
ADVANTAGE PRO 486DX/33;SX/25, BRAVO LC 4/25S; 33; 33S; 50D; 4'66D	2MB	500987-001	$88
	4MB	500987-002	$164
	8MB	500987-003	$328
PREMIUM 386/25; 33; 33T II 386SX/16;20;25	1MB	500780-003	$48
	1MB	500780-002	$48
ADVANTAGE 486/25; 33;33P;SX20, BROVO 4/33; 486/25; PREMIUM 4/25; 33TE; SE 4/33	2MB	500718-004	$84
	2MB	500780-005	$84
ADVANTAGE 486/25;33;33P;SX20,POWER PREMIUM 3/33;433; 335; 50D;66D; PREMIUM 386/33TE, 486/25;E; 25TE; 33; 33TE; PREMIUM II 386/25; 33, 486/33, 486SX/20 PREMIUM SERVER SE 4/33	4MB	500780-004	$178
	8MB	500780-001	$330

AST LAPTOP

POWER EXEC 3/25SL, 3/25SLC,EL	4MB		$178
	16MB		$768
POWER EXEC 4/25SL	4MB		$178
	16MB		$768
PREMIUM EXEC 286, 386SX/20;25;25C	4MB		$148
BRAVO NB486	4MB		$198
	16MB		$818

COMPAQ Memory

MODEL	MEMORY	PART#	PRICE
Deskpro 286E; 386-20, 20E; 25; 25E	1MB	113131-001	$59
	4MB	113132-001	$188
Deskpro 386S	4MB Board	113634-001	$254
	4MB Module	112534-001	$188
Deskpro 386-20E; 25E	4MB	113645-001	$238
Deskpro 386/33/33l; 486/25; 33L;50L; Systempro	2MB	115144-001	$108
	8MB	116561-001	$378
	32MB	116568-001	$1458
Systempro; Deskpro	6 SKT EXP BRD W/2MB	116569-001	$268
Compaq "M"	2-64MB	129160-001	$188
Deskpro 286N; 386N; 386SX/20; 20N, Portable 486c, Deskpro M, Systempro LT Series 129160-001, Pro Signia	1MB	118688-001	$49
	2MB	118689-001	$84
	4MB	118690-001	$168
	8MB	128877-001	$348
Prolina 3/25 & 25Z	2MB	141738-001	$88
	8MB	141742-001	$318
Prolina 4/25si, 4/33, 4/50	2MB Module	141683-001	$94
	4MB Module	141684-001	$178
	8MB Module	141685-001	$338
Compaq Pro Signia	16MB	149320-001	$684
	32MB	149147-001	$1524
DeskPro 5/60, 5/66M	8MB	149911-001	$388
Prosignia PC Server, 486/33/66	8MB	141685-001	$348
	16MB	149320-001	$648
	32MB	149147-001	$1498
Prosignia 5/60	16MB	149949-001	$698
Proliant 100 5/60	32MB	149912-001	$1398
Proliant 2000 4/30, 5/66	64MB	149913-001	$2698
Proliant 4000 4/50, 5/66	128MB	149914-001	$5600

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	4MB	139498-001	$174
	8MB	139499-001	$318
Contura 4/25CX	4MB	146520-001	$178
	8MB	146521-001	$338
	16MB	146532-001	$718
SLT/286	1MB	110235-001	$75
	4MB	110237-001	$218
SLT386	1MB	118303-001	$79
	2MB	118304-001	$108
	4MB	118305-001	$198
Lte 286	1MB	117081-001	$79
	2MB	117081-002	$99
	4MB	117081-004	$178
Lte 386S/20	1MB	121125-001	$98
	4MB	121125-002	$208
Lte Lite/20, 25, 25C	2MB	129769-001	$138
	4MB	129769-002	$208
	8MB	129769-003	$388
	16MB	129769-004	$808
LTE Lite 486/25C	4MB	142337-002	$178
	8MB	142337-003	$348
	16MB	142337-004	$718
Aero 3.3volt	4MB	190532-001	$188
	8MB	190597-001	$358

LAPTOP & NOTEBOOK MEMORY

MODEL	MEMORY	PART#	PRICE
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Dec pc 320 Notebook	2MB Mod	FR-PCIM-BA	$149
	4MB Mod	FR-PCIM-BB	$298
	8MB Mod	FR-PCIM-BD	$498
Epson NB-3 Notebook	4MB	A808511	$198
Epson NB-SL/	2MB Mod	A808771	$168
EPSON 25C Notebook	4MB Mod	A808781	$228
Everex Tempo LX, LX20	2MB	00160	$98
Everex Carrier	2MB	00263-00	$108
Gateway 2000 Nomad 425 DXL/SXL	4MB		$188
	16MB		$1475
Gateway 2000 486	4MB		$188
	16MB		$781
Grid 1500	4MB	52587	$238
Grid 1450SX	2MB	6200203	$148
Goldstar GS520, 386SX16	1MB	N/A	$98
	4MB	N/A	$298
NCR 3120 Notebook	4MB Mod	3120K104	$299
NCR 3170 Notebook	4MB Mod	3123K104	$399
Packard Bell, Magnavox, Mitsuba	1MB	N/A	$108
	4MB	N/A	$198
Panasonic CF170/270/370	1MB	CF-BA165	$64
Samsung Notemaster 386S	2MB	SNM002	$195
	4MB	SNM004	$395
Sanyo 17NB; 18NB & ZEOS	2MB	MBC-NBMEM2	$98
Sharp 6220	1MB	CE-621B	$78
Sharp 6640,6781,6681,6785	4MB	N/A	$198
Sharp 4700MZ-200	1MB	CE-471	$198
Sharp 8501 Colorstar	2MB	N/A	$398
TI Travelmate 2000	1MB	2568034-0011	$78
TI Travelmate 3000SX; WINSX	2MB	2566996-0001	$84
TI Travelmate 4000, WINDX/25 SX/16, SX25, DX2/40	4MB	2581265-001	$188
DX2/50	16MB	AVAILABLE	$1298

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MODULE	1MEG	2MEG	3MEG	4MEG	5MEG	8MEG
Canon LBP4, 4 Lite & 4+	$108	$144				
Epson Action Laser II, 8000	$88		$198		$268	
Epson + 6000 and many more		$128		$198		
Epson Action Laser 1000 & 1500		$118		$218		$399
Fujitsu 7100 & 7200	$199	$279				
HP Deskjet 500, 500C, 510, 550C and 560			$38 (256K)			
HP 2, 2D,		$98		$164		
HP 3, 3D, 3P, 2P, 2P+		$98		$168		
HP Laser Jet 4, 3Si, XL300, 1200C		$84		$168		$318
IBM Laser 4019, 4019E (3.5MB)		$114		$164		
IBM Laser 4029 ALL MODELS		$95		$155		
NEC 90, 290		$104				
NEC 95		$88				
OKI 400	$68	$88				
Packard Bell PB9500		$125		$208		
Panasonic 4410/4430		$118		$174		
Panasonic 4420/4450		$118		$178		
Panasonic 4450	$98					
Panasonic 4400/5400		$129		$198		
QMS 410	$119	$159		$249		
Tosiba Page Laser 6		$99		$168		
TIXL/PS17/PS35	$44	$98				

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32Kx8 (3.3V)	–	–	14.50	–
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64Kx4	–	11.00	9.00	8.00
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128Kx8	–	59.00	39.00	29.00

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1Megx4	–	59.00	55.00	54.00	–
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	8Meg	500987-003		330.00
	16Meg	500987-004		619.00
	32Meg	500987-005		1399.00
Premium 486/25, 25E, 33, 33E				
Premium 386/33TE, 486/25TE, 33TE				
Prem. Serv., Prem II 386SX/20, 25				
Prem. II 386/25, 386/33, 486/33, 486SX/20	8Meg	500780-001	64 pin	398.00
Premium 386/33T, Prem. 386SX/16				
Prem. II 386SX/20, 25	4Meg	500780-004		189.00
Premium 386/25, 33, 386/33T, 386SX/16,	1Meg	500780-003		59.00
Prem. II 386SX20,25	1Meg	500780-001		59.00
Premia 4/33S, 4/33, 4/50D, 4/66D	8Meg	501159-002		379.00
Premia	16Meg	501159-003		789.00
Premia	32Meg	501159-004		1469.00
Premia	64Meg	501159-005		3111.00
AST Cupid Bd	0-32Meg	500818-001		179.00

ZENITH MEMORY MODULES

MODEL	AMT. UPGRADED	AST PART #	PRICE
Z386/33, 25, 20, 33E	1Meg	ZA3800ME	59.00
Z386/33, 25, 20, 33E, 486/25E	4Meg	ZA3800MK	180.00
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6450375 (1Meg)	80-041	79.00
6450379 (2Meg)	80-111, 311-121, 321, 081, 161	84.00
6451060 (4Meg)	80-A21, A-61, 80-A31, 80-111, 80-311	189.00
6450604/92G7196 (2Meg)	70-061, E61, 121, 50Z, 55SX, 65SX, P-70 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	99.00
6450608 (2Meg)	70-A21, A-61, B-21, B-61, 35SX, 35LS, 40SX, Val Pt. 325T	90.00
78X8955 (128K)	25	35.00
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87F9977/92G7199 (4Meg)	55SX, 55LS, 65SX, 40SX, 35SX, 35LS	175.00
1057035 (512K)	P/S1-286	49.00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	109.00
92F9694 (4Meg)	P/S1 & P/S1/386SX, Model-2121	189.00
92G7200 (4Meg)	PSI Expert, Consultant, Willow	175.00
92G7201, 73G3131 (4Meg)	Value Point Performance, PC Server 4/66	175.00
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6450129/92G7428 (8Meg)	35SX, 40SX	339.00
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60G0378 (8Meg)	Thinkpad 350, 350c, PS Note 425	339.00
60G0379 (16Meg)	Thinkpad 350, 350c, PS Note 425	649.00
92F8804 (2Meg)	N45SL	109.00

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MODEL		AMT. UPGRADED	CMPQ PART #	PRICE
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486/25, 486/33L,		8Meg Module	116561-001	399.00
486/50L, System Pro		32Meg Module	116568-001	1399.00
DeskPro 386/33L, 486/33L		(Exp Bd)	116569-001	279.00
DeskPro 386/25, 386/20		1Meg Module	113131-001	79.00
		4Meg Module	113132-001	199.00
DeskPro 386S-16MHz		1Meg Exp Bd	113633-001	149.00
		4Meg Exp Bd	113634-001	279.00
		1Meg Module	113646-001	79.00
		4Meg Module	112534-001	199.00
DeskPro 386/20E		1Meg Exp Bd	113644-001	149.00
DeskPro 386/25E		4Meg Exp Bd	113645-001	279.00
		1Meg Module	113131-001	79.00
		4Meg Module	113132-001	199.00
DeskPro 286N, 386N, 386SX20,		1Meg Module	118688-001	59.00
all "M" series, sytem LT series,		2Meg Module	118689-001	89.00
all "T" series		4Meg Module	118690-001	169.00
		8Meg Module	128877-001	339.00
M Series Exp Bd		0-64Meg	129160-001	189.00
DeskPro 386/16		1Meg Kit	108071-001	99.00
		4Meg Kit	108072-001	299.00
		1-2Meg Exp Bd	108069-001	239.00
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DeskPro 286		512K Kit	113012-001	49.00
DeskPro 5/60, 5/66M, 5/66M	ALL OF THESE MACHINES USE THESE MODULES	8Meg Kit	149911-001	389.00
Prosignia 5/60		16Meg Kit	149949-001	699.00
Proliant 100 5/60		32Meg Kit	149912-001	1356.00
Proliant 2000 4/30, 5/66		64Meg Kit	149913-001	2516.00
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Prolinea 486 4/25S, 4/33, 4/50, 4/66, CDS		2Meg	141683-001	95.00
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		8Meg	141685-001	339.00
Prosignia PC Server, 486/33,		8Meg	141685-001	339.00
486 DX2/66		16Meg	149320-001	629.00
		32Meg	149147-001	1349.00

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LTE/286	4Meg Bd	117081-003	179.00
LTE/386S/20	4Meg Module	121125-002	209.00
LTE LITE/20, 25, 25C	4Meg Module	129769-002	209.00
LTE LITE/20, 25, 25C	8Meg Module	129769-003	409.00
LTE LITE/20, 25, 25C	16Meg Module	129769-004	809.00
LTE LITE 425C/33C/25E/25L	4Meg Module	142337-002	189.00
LTE LITE 425C/33C/25E/25L	8Meg Module	142337-003	349.00
LTE LITE 425C/33C/25E/25L	16Meg Module	142337-004	718.00
SLT/286	4Meg Module	110237-001	219.00
SLT/386	2Meg Module	118304-001	109.00
SLT/386	4Meg Module	118305-001	219.00
Concerto, LTE Elite	4Meg	144790-001	189.00
	8Meg	144790-002	369.00
	16Meg	144790-003	719.00
Contura 320, 325	2Meg	139497-001	99.00
	4Meg	139498-001	189.00
	8Meg	139499-001	339.00
Contura 400	4Meg/8Meg/16Meg		209/389/719
Contura 4/25, 4/25C, 4/25CX	4Meg	146520-001	189.00
	8Meg	146521-001	339.00
	16Meg	146531-001	699.00
Aero 4/25, 4/33L	4Meg	190532-001	184.00
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T1000SE/XE/LE	2Meg	PC14-PA8312U	89.00
T2000/T2000SX	2Meg	PC18-PA8317U	89.00
T2000SX/T1000LE	4Meg	PC-PA8314U	189.00
T2000SX/T1000LE	8Meg	PC14-PA8315U	359.00
T2000SXE/2200SX/T1800, 1850, C	2Meg	PC-PA2000U	89.00
T2000SXE/2200SX/T1800, 1850, C	4Meg	PC-PA2001U	189.00
T2000SXE/2200SX/T1800, 1850, C	8Meg	PC-PA2002U	359.00
T4400SX, SXC T6400, T6600	4Meg	PC-PA2004U	189.00
T4400SX, SXC T6400, T6600	8Meg	PC-PA2005U	359.00
T4400SX, SXC T6400, T6600	16Meg	PC-PA2010U	699.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	4Meg	PC-PA2012U	209.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	8Meg	PC-PA2013U	389.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	16Meg	PC-PA2014U	769.00
T3300SL	6Meg	PC-PA2008U	268.00
T3300SL	16Meg	PC-PA2009U	699.00
T3400CT, T2400, T3600	4Meg	PC-PA2019U	194.00
T3400CT, T2400, T3600	8Meg	PC-PA2020U	369.00
T3400CT, T2400, T3600	16Meg	PC-PA2021U	763.00
T3400CT	32Meg		1549.00
T1200XE	2Meg	PC13-PA8306	99.00
T1600	2Meg	PC8-PA8302U	99.00
T3100	2Meg	PC3-PA7135E	139.00
T3100e	2Meg	PC9-PA8340U	109.00
T3100SX	2Meg	PC15-PA8308U	109.00
T3100SX	4Meg	PC15-PA8310U	189.00
T3200	3Meg	PC6-PA7137U	185.00
T3200SX	2Meg	PC12-PA8307U	119.00
T3200SX	4Meg	PC12-PA8909	199.00
T3200SXC	2Meg	PC19-PA8318U	119.00
T3200SXC	4Meg	PC19-PA8319U	199.00
T5100	2Meg	PC7-PA8301U	95.00
T5200/T8500	2Meg	PC10-PA8304U	114.00
T5200/T8500	8Meg	PC10-PA8313U	419.00

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
ACER 730, 735C, 780	2Meg/4Meg/8Meg		109/209/399
ACER 750	4Meg/8Meg/16Meg		199/459/869
ALR Venture	4Meg	12407980	249.00
AST Ascentia 900N, 800N	4Meg/8Meg/16Meg		199/379/699
AST Bravo & Explorer	4Meg/16Meg	501255-001, -002	189/669
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	189.00
AST Power Exec 3/25C, 425EL, 425SL	4Meg/16Meg	501166-001, -003	199/699
AST Power Exec 4/33SL	4Meg/16Meg	501318-001,002	194/769
AT&T Safari NSX/20	4Meg	PEC 37651	259.00
Bondwell B310, Plus	1Meg	23050-09100	109.00
Bondwell B310V, SX	1Meg		109.00
Bondwell B310V, SX	4Meg		229.00
Canon Innova 486	2Meg/4Meg/8Meg		109/209/449
Canon Innova 486-10	4Meg/16Meg		189/829
Canon Notejet 486	4Meg/ 8 Meg		199/389
Dell Latitude	4Meg/16Meg		199/749
Epson Action Note 700	4Meg/16Meg		199/689
Epson NB3	4Meg	A808511	199.00
Everex Tempo LX, LX20, Carrier	2Meg	PCA 00053-0001	109.00
Gateway 2000 Colorbook 4/33	4Meg/16Meg		199/699
Gateway 2000 Nomad 425 DXL/SXL	4Meg/16Meg		199/1199
Gateway 2000 486 Handbook	4Meg/16Meg		199/679
Goldstar GS520 386SX/16	4Meg	S386-4M	249.00
Grid 1720, 1750, 1755	1Meg		59.00
HP Omnibook 300, 480, 425	2Meg/4Meg		129/269
HP Omnibook 530	4Meg/8Meg/12Meg		239/449/819
Magnavox Metalis	1Meg/4Meg	286, 386SX	109/199
NCR Safari 3180	4Meg/ 8 Meg		239/449
NEC Prospeed 386	2Meg	PC31-21	119.00
NEC Prospeed 386	8Meg	PC31-22	399.00
NEC Prospeed 286, 386SX-16, 386SX-20	1Meg	PC21-21, PC43-21	79.00
NEC Prospeed 286, 386SX-16, 386SX-20	4Meg	PC21-22, PC43-22	199.00
NEC Ultralite Versa, E, V	4 Meg/8Meg/16Meg/20Meg	OP4104	183/359/739/919
NEC Versa Removable Hard Drive	340Meg/524Meg		799/1169
NEC Versa S	4Meg/8Meg/16Meg		229/399/799
Packard Bell 386SX, 286	1Meg, 4Meg	286, 386SX	109/199
Packard Bell Statesman	2Meg/8Meg		119/369
Panasonic CF170, CF270, CF370	1Meg	CF-BA165	59.00
Panasonic CF380, CF480	2Meg/4Meg/6Meg		119/199/309
Panasonic CF-V21P, CF-580	4Meg/16Meg		219/819
Sanyo 17/18 NB	2Meg	MBC-NBMEM2	109.00
Sharp 6781, 6881, 6785, 6700, 6800, 6741	2Meg/4Meg		109/199
Sharp 8150, 8650, 8660, 7700, 7760	4Meg/16Meg		199/679
Sharp PC-6220	1Meg	CE 6218	79.00
Tandon, PC Brand, Datawond	2Meg/8Meg	NB386SX-20	119/349
TI Travelmate 2000	1Meg	2568034-0001	79.00
TI Travelmate 3000	2Meg	2566996-1	84.00
TI 4000, TI 4000E	4Meg/16Meg		199/999
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Tandy 2820, 3820, 3830	2Meg/4Meg/6 Meg		119/199/309
Twinhead, Altima, Compudyne, 486SX, DX, Tandy 4860	4Meg/16Meg		199/679
Ultra 486 TS38	4Meg/8Meg/16Meg		249/459/899
Zeos 386SX Notebook (not the + version)	2Meg		109.00
Zenith Master Sport 386SX	2Meg	ZA-300-1	114.00
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286E, SX	2Meg	ZA-180-64	149.00
SX Alpha	2Meg	ZA-180-86	149.00
SX Beta	2Meg	ZA-180-87	149.00
Zenith Z-Note 325L, LC	2Meg/8Meg	ZA3250-4/5	129/419
Zenith Z-Note 425LN, LNC, LNP	4/8/16Meg		209/469/839
Zenith Z-Star 4/33	2/8Meg		119/369

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Canon LBP 860	–	–	–	99	–	–	179	–	–	349	669	1249
Canon LBP4, 4Lite, 4plus	–	–	159	219	–	–	–	–	–	–	–	–
Epson 6000, Action Laser	–	–	–	139	–	–	229	–	–	–	–	–
Epson Action Laser II	–	–	89	–	208	–	–	327	–			
Epson 8000	–	–	89	–	208	–	–	327	–			
Epson 1000, 1500	–	–	–	***119****	–	–	***238****	–	***Call***	–	–	–
HP 2, 2D–	–	–	–	109	–	–	189	–	–	–	–	–
HP 3, 3D, 3P, 2P 2P+	–	–	–	99	–	–	169	–	–	–	–	–
HP 4, 4M, 4SI, 4SIMX, 4P, 4MP	–	–	–	89	–	–	169	–	–	349	–	–
HP 4L	–	–	59	–	–	–	–	–	–	–	–	–
HP 3SI	–	–	69	–	–	–	169	–	–	349	–	–
HP 4SI	–	–	–	89	–	–	175	–	–	349	–	–
HP Design Jet 600, 650	–	–	–	–	–	–	175	–	–	349	–	–
HP Deskjet 500, 500C, 510, 550,560	–	55	–	–	–	–	–	–	–	–	–	–
HP Deskjet 1200C, 1200C/P	–	–	–	89	–	–	175	–	–	349	–	–
HP Paintjet XL300	109	–	–	–	–	–	289	–	–	469	837	–
IBM Laser 4019, 4019E	–	–	–	–	–	169	–	–	–	–	–	–
IBM Laser 4029, 4037	–	–	–	–	–	–	169	–	–	–	–	–
IBM Laser 4039, 4079	–	–	–	99	–	–	169	–	–	350	–	–
NEC 90, 290	–	–	–	139	–	–	–	–	–	–	–	–
NEC 95, 97	–	–	–	99	–	–	–	–	–	–	–	–
Oki 400	–	–	–	84	–	–	–	–	–	–	–	–
Oki 400E, 400EX, 410E, 410EX	–	–	135	189	–	–	–	–	–	–	–	–
Oki 830, 840	–	–	–	109	–	–	–	–	–	–	–	–
Packard Bell PB 9500	–	–	–	139	–	–	227	–	–	–	–	–
Packard Bell 9815	–	–	–	159	–	–	269	–	–	–	–	–
Panasonic 4420/4450I	–	–	–	129	–	–	209	–	–	–	–	–
Panasonic 4410/4430	–	–	–	126	–	–	195	–	–	–	–	–
Panasonic 4450	–	–	99	–	–	–	–	–	–	–	–	–
Panasonic 4400/5400	–	–	89	129	–	–	229	–	–	–	–	–
Panasonic 4440, 5410	–	–	109	179	–	–	Call	–	–	–	–	–
Sharp 9400, 9460, 9600, 9700E	–	–	89	149	Call	–	249	Call	Call	Call	–	–
TI XL/PS17/PS35	–	–	55	–	–	–	–	–	–	–	–	–
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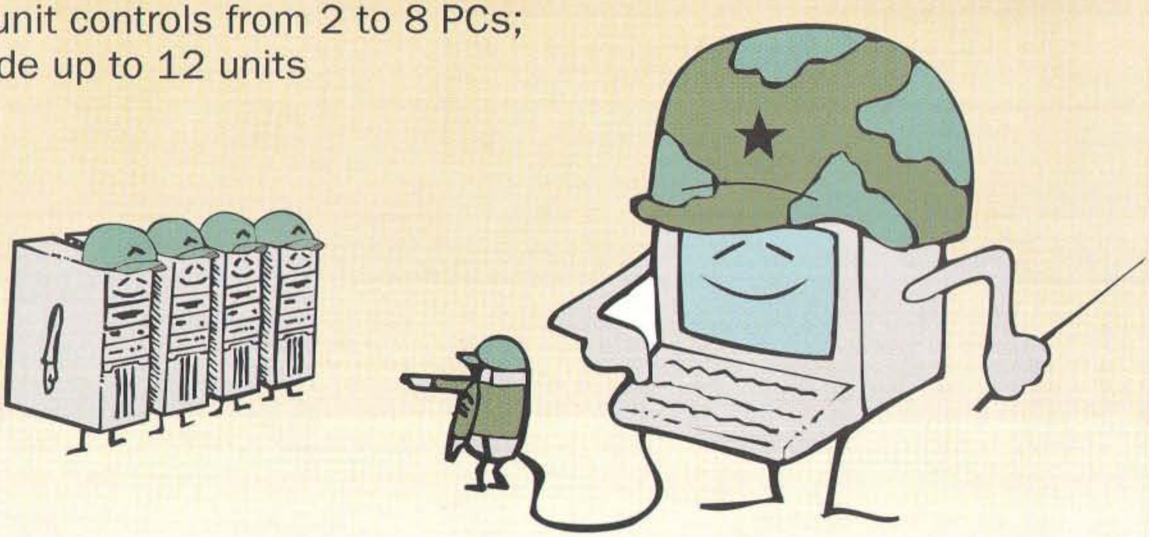

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Premium Exec 286, 386SX/20, 25, 25C	4MB	$169
NEW Bravo NB 486	4MB	$165
	16MB	$599

Compaq

Model	Memory	Price
NEW Aero	4MB	$180
	8MB	$275
NEW Concerto 486	4MB	$175
	8MB	$365
Contura 3/20, 3/25, 3/25c	4MB	$160
	8MB	$309
Contura 4/25 series	4MB	$167
	8MB	$315
LTE 386S/20	4MB	$180
NEW LTE Elite	8MB	$315
LTE Lite 20; 25; 25c, 25e	4MB	$200
	8MB	$350
	16MB	$725
LTE Lite 4/25c	4MB	$180
	8MB	$330

IBM

Model	Memory	Price
NEW PS/2 CL57SX and ThinkPad 700, 700c, 720, 720c, 755	4MB	$199
	8MB	$379
	16MB	$685
NEW ThinkPad 710T	4MB	$175
	8MB	$325
N51 Notebook (All)	2MB	$79
	4MB	$175
L40SX, N33SX, PS/Note 182	4MB	$175
L40SX, PS/Note 182	8MB	$319

NEC

Model	Memory	Price
NEW UltraLite Versa (all models)	4MB	$170
	8MB	$349
(Excluding 40E & 50E models)	16MB (3.3V)	$679
UltraLite III, SL/25C	2MB	$85
	6MB	$279
UltraLite SL/20, SL/20P	2MB	$85
	6MB	$279
ProSpeed 286, 386SX/16	4MB	$179

Texas Instruments

Model	Memory	Price
TravelMate 3000 (all models)	2MB	$79
NEW TravelMate 4000 (all models)	4MB	$185
	16MB	$1,189

Toshiba

Model	Memory	Price
T1000SE/LE/XE; 2000, 2000SX; SXe,	2MB	$89
T1200XE, 1600, 3100E	2MB	$89
T2200SX, T1800 Series	4MB	$169
	8MB	$319
NEW T2400	4MB	$185
T3100SX, 3200SX, SXC	2MB	$79
	4MB	$165
T3300SL	4MB	$165
	8MB	$389
	16MB	$819
NEW T3400	4MB	$165
	8MB	$359
T4400, T6400 (all models)	4MB	$179
	16MB	$675
NEW T1900, T4500, T4600, T4700 (all models)	8MB (3.3V)	$349
	16MB (3.3V)	$599
T5400, T5200; T5200C, T8500	2MB	$99

Zenith

Model	Memory	Price
Z-Note 320L, 320Lb, 325L, 325Lc	2MB	$95
	8MB	$329
NEW Z-Note 425 Series	8MB (3.3V)	$369
Z-Sport 420S, 425S	4MB	$189
MastersPort 386SL, SLC, SLe	2MB	$85
MastersPort 386SX	2MB	$85
NEW Z-Star	4MB	$159
	8MB	$369

SIMMS

SIMM	Price
1x9 (3-chip)	$37
4x9	$134
1x36	$145
2x36	$304

SIMM	Price
1 x 9-70ns (9 chip) (1MB)	$38
512K x 36-70ns (2MB)	$75
1 x 36-70ns (4MB)	$145
2 x 36-70ns (8MB)	$304
4 x 36-70ns (16MB)	$619

PERSONAL COMPUTER MEMORY

AST

Model	Memory	Part No.	Price
NEW Premmia	4MB	501159-001	$159
	8MB	501159-002	$349
Bravo 3/25s	2MB	500710-004	$89
	8MB	500824-002	$308
Advantage! 386SX/20; 25, Advantage! Pro SX/25, Bravo 3/33s	2MB	500962-001	$79
	8MB	500962-002	$274
Advantage! Pro 486DX/33; SX/25, Bravo LC 4/25s; 33; 33s; 50d; 4/66d	2MB	500987-001	$71
	4MB	500987-002	$155
Premium 386/25; 33; 33T, Premium II 386SX/16; 20; 25	1MB	500780-003; 002	$45
Advantage! 486/25; 33; 33p; SX20, Bravo 4/33; 486/25; Premium 4/25; 33TE, Server SE 4/33	2MB	500718-004; 780-005	$79
Advantage! 486/25; 33; 33p; SX20, Power Premium 3/33, 4/33; 33s; 50d; 66d, Premium 386/33TE, 486/25; E; 25TE; 33; 33E; 33TE, Premium II 386/25; 33, 486/33, 486SX/20 Premium Server SE 4/33	4MB	500780-004	$188
	8MB	500780-001	$339

Compaq

Model	Memory	Part No.	Price
ProLinea 3/25s; 3/25zs	2MB	141738-001	$86
	8MB	141742-001	$308
NEW ProLinea 4/25s, 4/33, 4/50	1MB	141682-001	$42
	2MB	141683-001	$80
	4MB	141684-001	$174
	8MB	141685-001	$346
DeskPro 386-20, 25	4MB	113132-001	$190
	4MB	113645-001	$239
DeskPro 386s/16	4MB	112534-001	$190
	4MB	113634-001	$239
NEW DeskPro 3/25i; 33i,4/25iS; 33i; 66i, 286N; 386N; 386SX/20; 20N, SystemPro LT Series, Portable 486c, M Series	2MB	118689-001	$79
	4MB	118690-001	$174
	8MB	112877-001	$346
ProSignia PC Server 486/33; DX2/66	16MB	149320-001	$619
DeskPro 386-33, 486-33, SystemPro	2MB	115144-001	$94
	8MB	116561-001	$359

Dell

Model	Memory	Part No.	Price
Power Desktop 325D; P, 333D, 333P, 433P, 486P, 486D	4MB	310-2507	$174
PowerLine Workstation 420; 425; 433; 450; 450DE/2, 466DE	2MB	310-2466	$79
	8MB	310-2468	$346
NEW PowerLine Workstation 420; 425; 433; 450; 450SE/2, 466SE	32MB Kit	310-2630	$1,199
Performance T, L, & M series	4MB	310-3315	$174
	16MB	310-3317	$619

Hewlett-Packard

Model	Memory	Part No.	Price
Vectra QS/16S; 20PC, RS/20; 20C; 25, 25C	4MB Kit	D1542 or 1642A	$177
Vectra 386/16N, 386/20N, 386/25N PC	2MB	D2406A	$89
	8MB	D2404A	$308
Vectra 486PC; 25T; 33T; 486s/20; 4/25N; 33N; 50N; 66N	2MB	D2381A	$80
	8MB	D2152A	$346
Vectra 386/25; 486/25U; 486/33U; 486/50U; 486/66U	2MB	D2381A	$80
	8MB	D2152A	$346
Vectra 386/33N; 33NI	2MB	D2714A	$98
	8MB	D2715A	$308

IBM

Model	Memory	Part No.	Price
NEW AMBRA Enterprise 386, Hurdla 386, Sprinta 386 (all models)	2MB	N/A	$94
	8MB	N/A	$329
NEW AMBRA Enterprise 486, Hurdla 486, Sprinta 486 (all models)	4MB	N/A	$195
	16MB	N/A	$659
PS/1 286, 386SX	2MB	92F9935	$79
	4MB	92F9694	$159
PS/1 Consultant, Essential, Expert models x43, x44, PS/Valuepoint all models except Cxx series	4MB	96F9290	$174
PS/1 Consultant, Essential, Expert models x76	16MB Kit	96F9291	$615
PS/2 25/286, 30/286, memory adapter 1497259	2MB Kit	30F5360	$75
PS/2 35SX; LS, 40SX, 50Z, 55SX; LS, 65SX; LS, 70, XStation	2MB	6450604	$80
PS/2 70-A21; A61; B21; B61, PS/1 Consultant, Essential, Expert models x11, x13, x14, PS/Valuepoint Cxx series	2MB	6450608	$80
PS/2 35SX; LS, 40SX, 55SX; LS, 65SX; LS, XStation, PS/Valuepoint Cxx series, adapter board 34F3011 or 34F3077	4MB	34F2933 or 87F9977	$174
PS/2 35SX; LS, 40SX, PS/Valuepoint Cxx series	8MB	6450129	$346
PS/2 90 XP, 95 XP, P75 (pairs), 56, 57 (all), PS/1 Pro M2123	2MB	6450902	$80
PS/2 90 XP, 95 XP, P75 (pairs), 56, 57 (all), PS/1 Consultant, Essential, Expert models x11, x13, x14, PS/1 Pro M2123	4MB	6450128	$174
	8MB	6450130	$346
Expansion boards for 50, 50Z, 55SX, 60, 65SX	2-8MB w/2MB	1497259	$159

NEC

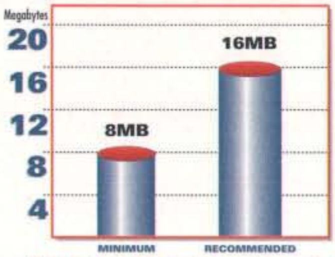
Model	Memory	Part No.	Price
NEW Image 425, 433, 466	4MB	410-12002	$174
	16MB	410-12003	$619
Ready 425, 433	4MB	N/A	$174
	16MB	N/A	$619
PowerMate 286/12; SX/16, SX/20	2MB Kit	OP-410-8103	$89
PowerMate SX/20	2MB CPU Upgrade	OP-410-8101	$139
	2MB Exp. Board	OP-410-8102+8103	$176

Zenith

Model	Memory	Part No.	Price
Z-Server 425SE, 433DE, 450DE	4MB	ME-432	$174
	8MB	ME-102	$346
Zenith Z-386/20; 25; 33, 33E	1MB	ZA3800ME	$42
	4MB	ZA3800MK	$174
Zenith Z-386SX/20, 286LP+, Z-LS	2MB Kit	Z-605-1	$89

WHY ADD MORE MEMORY?

Increase Windows & OS/2 Performance!



These two operating environments run most applications satisfactorily with 8MB, but in the long run 16MB is recommended

- Memory allows Windows & OS/2 to run faster
- Reduces your system's need to access the hard disk
- Utilize numerous & extensive applications at the same time

**This graph displays the amount of memory it takes to run Windows & OS/2 applications more efficiently.*

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* Interface card not included

(Drives & Cartridges may be purchased separately)

CARTRIDGES

Cartridge	Price
105MB	$59
270MB	$89

CPU UPGRADES

Cyrix

486 Upgrades

Upgrade	Price
Cx486DRx²-33/66	$249
Cx486DRx²-25/50	$209
Cx486SRx²-25/50	$209

Evergreen

NEW Evergreen Rev to 486

Upgrade	Price
386SX16, 20 x2/x3	$209/$409
386DX25 x2/x3	$229/$419
386DX33 x2/x3	$459/$669

Intel

Intel OverDrive Processors

Upgrade	Price
OverDrive 486DX-50 for 486SX16, 20, 25	$175
OverDrive 486DX-66 for 486DX33	$235
NEW OverDrive 486DX4-75	$460
OverDrive 486DX4-100	$555

Kingston

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Upgrade	Price
25MHz (SLC)	$219
50MHz (SLC)	$299

LASER MEMORY

Printer	Memory	Part No.	Price
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	2MB	N/A	$145
HP LaserJet IIIsi, 4, 4M, 4Si, 4SiMX, XL300, InkJet 600	4MB	C2065A	$174
	8MB	C2066A	$346
HP LaserJet IIP, III, IIIP, IIID	2MB	33475B	$97
	4MB	33477B	$179
HP LaserJet II & IID	2MB	33444B	$110
	4MB	33445B	$195
NEW HP LaserJet 4P & 4MP	2MB	C3131A	$89
	4MB	C3132A	$179
HP LaserJet 4L	1MB	C2024A	$48
IBM Laser 4029 all models	2MB	1183334	$96
	4MB	1183335	$157
OkiLaser 400	1MB	70014701	$67
	2MB	N/A	$106
Panasonic 4410 & 4430	2MB	KX-P444	$126
	4MB	N/A	$191
Panasonic 4450I & 4420	2MB	KX-P441	$129
	4MB	N/A	$189
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ST5660A	545MB	12MS	3.5 1"	IDE	209
ST31220A	1.05GB	9MS	3.5 1"	IDE	539
ST43400N	3.5GB	11MS	5.25"FH	SCSI-2	1850
ST31200N	1.05GB	09MS	3.5 1"	Fast SCSI-2	568
ST11950N	1.68GB	08MS	3.5" HH	Fast SCSI-2	1195
ST12550N	2.14GB	08MS	3.5" HH	Fast SCSI-2	1219
ST11950N	1.6GB	08MS		Fast SCSI-2	1195
ST12400N	2.1GB	09MS		Fast SCSI-2	1089
ST15230N	4.2GB	09MS		Fast SCSI-2	2075
ST15150N	4.2GB	08MS		Fast SCSI-2	2219
ST11900N	1.0GB	09MS	LP3.5"	Fast SCSI-2	1017
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MC2217	1.75GB	10MS	3.5"	SCSI-2	889
MC1936	3.0GB	11MS	FH	SCSI-2	1539
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CP540P	540MB	12MS	3.5" 1"	SCSI	274
CFA810A	810MB	10MS	3.5" 1"	IDE	390
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LPS340S	340MB	12MS	3.5X1"	SCSI	209
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8087-2 8MHZ	135	80287XLT 12MHZ	75	80387DX-25 25MHZ	75	83D87DX-20 20MHZ	59	83S87SX25 25MHZ	59	2087-20 20MHZ	64	3S87SX-16 16MHZ	59
8087-1 10MHZ	99	80387SX-16 16MHZ	75	80387DX-33 33MHZ	75	83D87DX-25 25MHZ	59	82S87XL	59	3087-16 16MHZ	59	3S87SX-20 20MHZ	59
80287-6 6MHZ	40	80387SX-20 20HZ	75	80487SX-25	345	38D87DX-33 33MHZ	59	**IIT**		3087-20 20MHZ	59	3S87SX-25 25MHZ	59
80287-8 8MHZ	50	80387SX-25 25HZ	75			83D87DX-40 40MHZ	80	2087-8 8MHZ	54	3087-25 25MHZ	59	3S87SX-33 33MHZ	59

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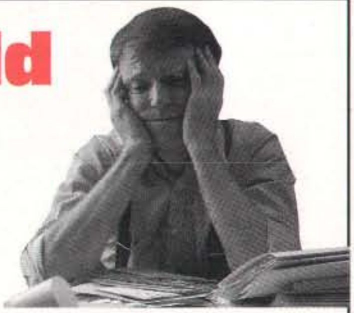

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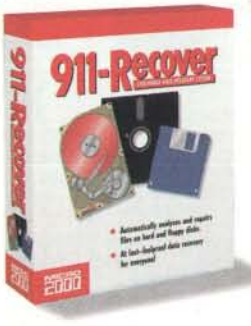

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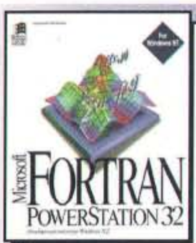

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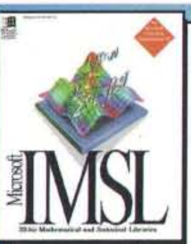

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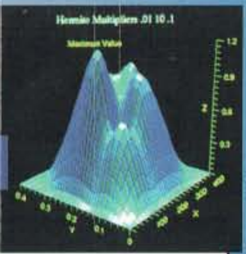

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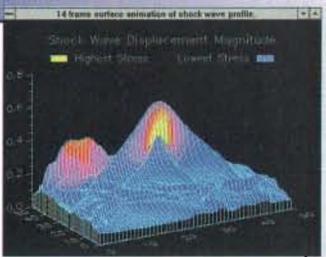
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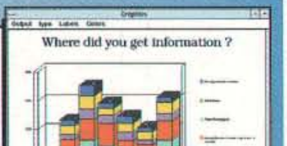

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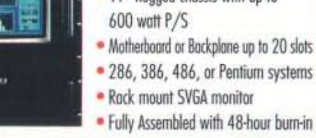

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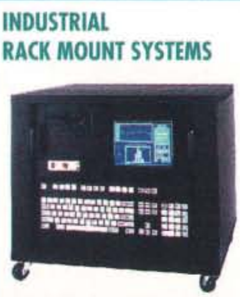

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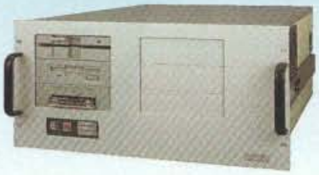

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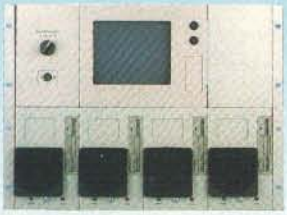

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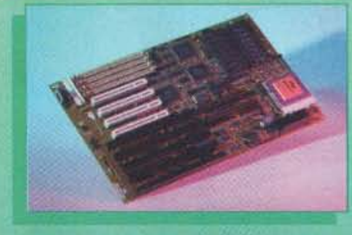

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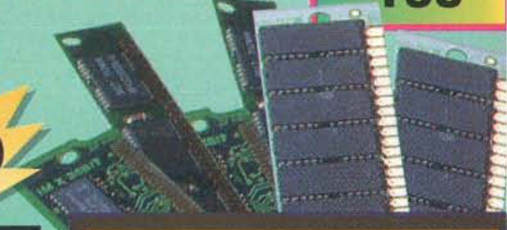

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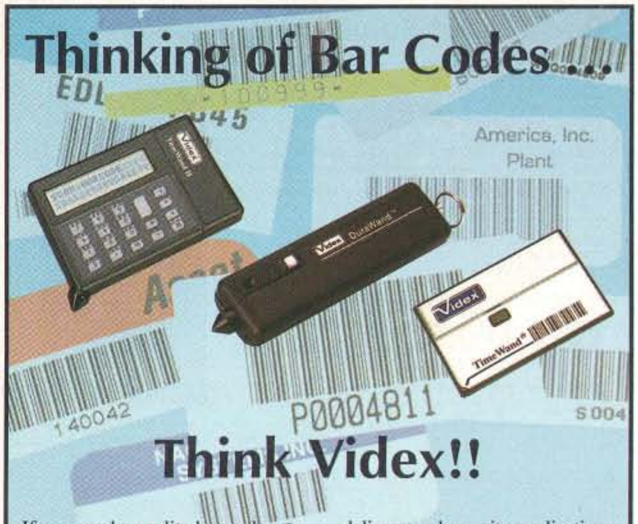

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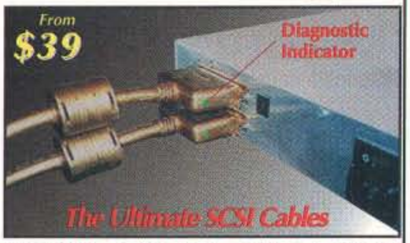

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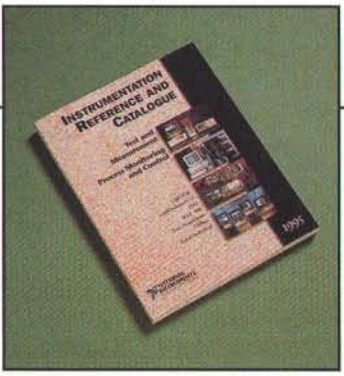

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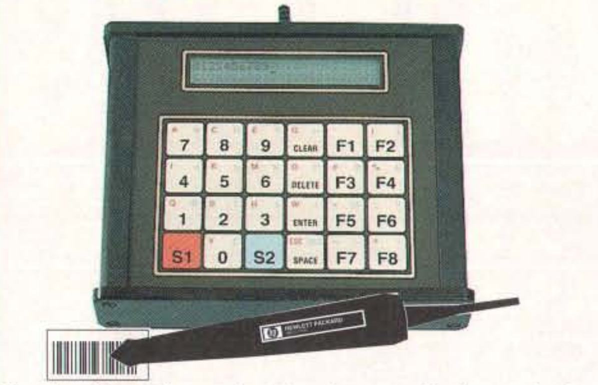

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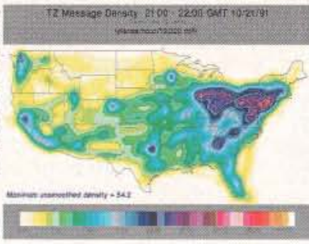
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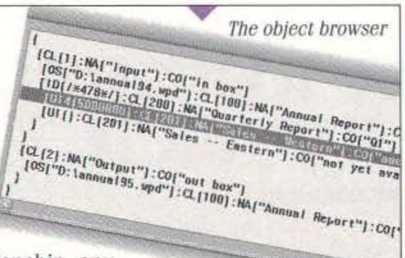

The object browser

```
{
 {CL[1]:NA["Input"]:CO["in box"]
  [OS["D:\annual94.wpd"]:CL[100]:NA["Annual Report"]:C
  [ID[/*478*/]:CL[200]:NA["Quarterly Report"]:CO["Q1"]
  [UI{]:CL[201]:NA["Sales -- Eastern"]:CO["not yet ava
 }
 }
 {CL[2]:NA["Output"]:CO["out box"]
  [OS["D:\annual95.wpd"]:CL[100]:NA["Annual Report"]:CO[
 }
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140	LOGICIELS ET SERVICES DUHEM	190	+33149700455
	M		
133-134	MAG INNOVISION	107	800-827-3998
527	MANNESMANN TALLY	48IS 21	+44 734 788711
296-297	MARX DATENTECHNIK GMBH	164	+49-8403-1555
*	MCGRAW-HILL ONLINE (INT'L)	59	
282-283	MEDIA ON (N.A.)	31	800-552-7835
249-250	MENAI CORP	283	800-GAMELON
180	MICRO 2000	268	800-864-8008
181	MICRO 2000	271	800-864-8008
172-173	MICRO SOLUTIONS COMP PROD	257	800-295-1214
174-175	MICRO SOLUTIONS COMP PROD	259	800-295-1214
273	MICRO-INTERNATIONAL INC	161	800-967-5667
*	MICROSTAR LABORATORIES	279	206-453-2345
89	MICROWAY	236	508-746-7341
126	MINICOM / CLASSNET VIDEO	84	+972-2-637576**
518-519	MINUTEMAN	48IS 11	214-446-7363
224-225	MYSTIC SOFTWARE	283	800-697-8426
	N		
92-93	NANAO USA CORP (N.A.)	99	310-325-5202
90-91	NANAO USA CORP (N.A.)	213	310-325-5202
205	NATIONAL INSTRUMENTS	281	512-794-0100
514-515	NATIONAL INSTRUMENTS	48IS 12	512-794-0100
*	NEC	38-39	
*	NEKOTECH	253	714-580-0055
*	NETWORK COMPUTING DEVICES (N.A.)	59	800-793-7638
*	NETWORKS SHOW '94	48IS 24	
171	NEVADA COMPUTER	256	800-982-2925
233	NEWVOICE	277	703-648-0585
95	NSTL	181	610-941-9600
94	NSTL / PC DIGEST	235	800-257-9402
	O		
246	OBJECT MANAGEMENT LAB	282	800-6789-OML
523	ON TIME MARKETING	48IS 24	+49-40-437472
*	OSBORNE MCGRAW-HILL	177	800-822-8158
*	OSBORNE MCGRAW-HILL	168-169	800-822-8158
	P		
191	PACIFIC COAST MICRO	274	619-581-6040
98	PANASONIC OFFICE AUTOMATION	214	800-742-8086
99-100	PC POWER & COOLING	53	800-722-6555
193	PC'S COMPLEAT	254-255	508-624-6400
101	PERSOFT INC	199	800-368-5283
102	PHAR LAP SOFTWARE INC	170	617-661-1510
520	PHILIPS MONITORS (INT'L)	8-9	+31 40 73 39 83**
103-104	PINNACLE MICRO	7	714-727-3300

ADVERTISER CONTACT INFORMATION

Inquiry No.		*Page No.*	*Phone No.*
105	PKWARE INC	86	414-354-8699
106	PKWARE INC	98	414-354-8699
141-142	PLEXTOR	61	800-886-2683
148-149	POLYCON GMBH DATA SYS	111	+49-521-9861322**
236	PRACTICAL ENHANCED LOGIC	276	800-345-SCSI
130-131	PROXIMA CORP	108	800-447-7694
	Q		
107	QNX SOFTWARE SYSTEMS LTD	195	800-676-0566 ext 1001
275-276	QUALCOMM	160	800-2EUDORA
206	QUALSTAR CORP	281	800-468-0680
259-260	QUARTERDECK OFFICE SYS	124	310-392-9851
298-299	QUARTERDECK OFFICE SYS	173	310-392-9851
150-151	QUARTON USA	200	800-520-8435
108-109	QUATECH INC	248	800-553-1170
	R		
530-531	RAIDTEC CORP	48IS 17	+353 21 821 454
110	RAINBOW TECHNOLOGIES	55	800-852-8569
229-230	RCI	277	908-874-4072 ext 71
547-548	RECOGNITA (INT'L)	99	+36-1-2018925
177	RECORTEC INC	273	800-729-7654
207	RHETOREX, INC.	277	408-370-0881
111-112	ROSE ELECTRONICS	232	800-333-9343
	S		
155	SAMSUNG ELECTRONICS	217	201-229-4053
113-114	SAMTRON DISPLAYS INC (N.A.)	211	310-802-8425
532	SAMTRON (INT'L)	105	+49 6196 74001
138-139	SCEPTRE TECHNOLOGIES	208	800-788-2878
208	SCIENTIFIC ENDEAVORS	282	800-998-1571
184-185	SCITECH INTERNATIONAL	269	800-622-3345
115	SEQUITER SOFTWARE INC	185	403-437-2410
132	SERIF INC	69	800-697-3743 code BY015
226-227	SHAFFSTALL CORP	281	800-248-3475
218-219	SIGMA TECH SOFTWARE	278	818-368-6132
240-241	SILICON WAREHOUSE	276	800-347-4887
209	SILICONSOFT INC	283	800-969-4411
292	SMC / STANDARD MICROSYSTEMS CORP	141	800-SMC-4-YOU dept EZ33
87-88	SMILE INTERNATIONAL INC (N.A.)	105	800-253-2872
266	SOFTBLOX INC (INT'L)	163	404-892-0202
265	SOFTBLOX INC (N.A.)	163	800-434-0202
116	SOFTWARE SECURITY	48	203-656-3932**
549-550	SOLID COMPUTER GMBH	48IS 25	+49-89-3159146**
117-118	SPSS INC	113	800-543-5835
516-517	STAC STORAGE & COMM	CIV	800-677-6232
96-97	STAC STORAGE & COMM	47	800-677-6232 ext 214
119	STATSOFT	95	918-583-4149
*	SUPRA CORP	17	800-727-8647
	T		
210	TALKING TECHNOLOGY INC	278	800-685-4884
120	TEKTRONIX	77	800-835-6100 ext 1066
*	TEXAS INSTRUMENTS	19	800-TI-TEXAS
121	TOSHIBA AMERICA INC	22-23	800-457-7777
528	TRAVELING SOFTWARE (INT'L)	73	+44-(0)1734 828830
215	TRI VALLEY TECHNOLOGY INC	278	510-447-2030
546	TYPHOON SOFTWARE (PC)	284	805-966-7633
	V		
211	VIDEX INC	276	503-758-0521
212	VIDEX INC	277	503-758-0521
122-123	VIEWSONIC	103	909-869-7976
	W		
521	WALKER, RICHER & QUINN	48IS 9	206-324-0407
124	WATCOM C/C++ 10.0	29	519-886-3700
277-278	WIBU (INT'L)	162	+49-721-93172-22
277-278	WIBU (U.S.)	162	301-570-3497
262	WINBOOK COMPUTER CORP (N.A.)	131	800-468-0712
179	WORLDWIDE TECHNOLOGIES	264	215-922-0116**
	X		
125	XEROX OFFICE DOCUMENT SYS	142-143	800 ASK XEROX ext 965
	Z		
261	ZEOS INTERNATIONAL	122-123	800-554-5226
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Category No.
Inquiry No. ***Page No.***

HARDWARE

1 ACCESSORIES/SUPPLIES

Inquiry No.		Page No.
267-268	AER ENERGY RESOURCES INC	144
135-136	ANTEX ELECTRONICS	178
228	H & R TECHNOLOGY	276
150-151	QUARTON USA	200

2 ADD-IN BOARDS

Inquiry No.		Page No.
159	ADAPTEC	272
135-136	ANTEX ELECTRONICS	178
75-76	CURTIS INC	100
166-167	DISTRIBUTED PROCESSING TECH	263
247-248	DTC ELECTRONICS HUNGARY	280
170	JAMECO ELECTRONICS	267
236	PRACTICAL ENHANCED LOGIC	276
108-109	QUATECH INC	248
240-241	SILICON WAREHOUSE	276
210	TALKING TECHNOLOGY INC	278

3 BAR CODING

Inquiry No.		Page No.
186-187	IGC INC	265
211	VIDEX INC	276
212	VIDEX INC	277

4 COMMUNICATIONS/NETWORKING

Inquiry No.		Page No.
190	ALTA RESEARCH CORP	284
543	ALTEX ELECTRONICS	260NE 2-3
544	ALTEX ELECTRONICS	260SO 2-3
526	AXIS COMMUNICATIONS (INT'L)	21
182-183	COROLLARY	258
244-245	CYCLADES CORP	276
247-248	DTC ELECTRONICS HUNGARY	280
533-534	ERGOTRON EUROPE	48IS 13
542	FLUKE EUROPE B.V.	48IS 32
*	HEWLETT-PACKARD	37
126	MINICOM / CLASSNET VIDEO	84
233	NEWVOICE	277
148-149	POLYCON GMBH DATA SYSTEMS	111
229-230	RCI	277
207	RHETOREX INC	277
111-112	ROSE ELECTRONICS	232
218-219	SIGMA TECH SOFTWARE	278
549-550	SOLID COMPUTER GMBH	48IS 25
210	TALKING TECHNOLOGY INC	278

5 COMPUTER SYSTEMS

Inquiry No.		Page No.
*	APPLE COMPUTER INC	2-3
178	APPRO INTERNATIONAL INC	270
*	ASPEN SYSTEMS	51
165	DATALUX CORP	252
*	DELL COMPUTER CORP (N.A.)	CIII
*	DELL COMPUTER CORP (N.A.)	CIV
79	DIGITAL ALPHASTATION	42-43
*	GATEWAY 2000	80A-J
*	GATEWAY 2000	80-81
551	INTEGRIX INC	48IS 29
*	INTEL CORP	12-13
85-86	INTERGRAPH	97
201	KILA	278
282-283	MEDIA ON (N.A.)	31
*	NEKOTECH	253
95	NSTL	181
94	NSTL / PC DIGEST	235
191	PACIFIC COAST MICRO	274
193	PC'S COMPLEAT	254-255
177	RECORTEC INC	273
549-550	SOLID COMPUTER GMBH	48IS 25
215	TRI VALLEY TECHNOLOGY INC	278
261	ZEOS INTERNATIONAL	122-123

6 DATA ACQUISITION

Inquiry No.		Page No.
195	AMERICAN ADVANTECH	278
198	GAGE APPLIED SCIENCES, INC.	278
200	IO TECH	278
204	KEITHLEY METRABYTE	279
203	LAWSON LABS INCORPORATED	279
*	MICROSTAR LABORATORIES	279
108-109	QUATECH INC	248

53 DIAGNOSTIC EQUIPMENT

Inquiry No.		Page No.
542	FLUKE EUROPE B.V.	48IS 32

7 DISKS & OPTICAL DRIVES

Inquiry No.		Page No.
238	CARROT COMPUTER	279
75-76	CURTIS INC	100
222-223	GRANITE DIGITAL	279
172-173	MICRO SOLUTIONS COMP PROD	257
174-175	MICRO SOLUTIONS COMP PROD	259
103-104	PINNACLE MICRO	7
141-142	PLEXTOR	61
530-531	RAIDTEC CORP	48IS 17

9 FAX BOARDS/MACHINES

Inquiry No.		Page No.
*	SUPRA CORP	17

10 GRAPHICS TABLETS/MICE/PEN INPUT

Inquiry No.		Page No.
274	DESIGN TECHNOLOGY	162

11 KEYBOARDS

Inquiry No.		Page No.
501	CHERRY MIKROSCHALTER GMBH	48IS 6-7
165	DATALUX CORP	252
231-232	ELMA ELECTRONIC	279
199	HOOLEON CORP	280

12 LAN HARDWARE

Inquiry No.		Page No.
502-503	COMPEX INC	48IS 23
269-270	CYBEX CORP	159
163-164	CYBEX CORP	261
506-507	CYBEX CORP (INT'L)	CIII
533-534	ERGOTRON EUROPE	48IS 13
168-169	FIRST SOURCE INT'L	262
542	FLUKE EUROPE B.V.	48IS 32
99-100	PC POWER & COOLING	53
148-149	POLYCON GMBH DATA SYSTEMS	111

13 LAPTOPS & NOTEBOOKS

Inquiry No.		Page No.
267-268	AER ENERGY RESOURCES INC	144
214	AMREL TECHNOLOGY INC	280
293	COMPAQ LTE ELITE PORTABLE (N.A.)	8-9
522	FIRST INTERNATIONAL COMPUTER	48IS 2
*	JDR MICRODEVICES	275
273	MICRO-INTERNATIONAL INC	161
193	PC'S COMPLEAT	254-255
121	TOSHIBA AMERICA INC	22-23
262	WINBOOK COMPUTER CORP (N.A.)	131
179	WORLDWIDE TECHNOLOGIES	264
261	ZEOS INTERNATIONAL	122-123

14 MAIL ORDER

Inquiry No.		Page No.
543	ALTEX ELECTRONICS	260NE 2-3
544	ALTEX ELECTRONICS	260SO 2-3
*	AMERICAN LUNG ASSOCIATION	260NE 4
*	AMERICAN LUNG ASSOCIATION	260SO 4
*	BYTE SUB MESSAGE	48IS 26
194	COMPUSTAR COMPUTERS	268
161	COMPUTER DISCOUNT WAREHOUSE	250-251
162	COMPUTERLANE UNLTD	266
170	JAMECO ELECTRONICS	267
171	NEVADA COMPUTER	256
193	PC'S COMPLEAT	254-255

15 MEMORY/CHIPS/UPGRADES

Inquiry No.		Page No.
168-169	FIRST SOURCE INT'L	262
*	INTEL CORP	12-13
170	JAMECO ELECTRONICS	267
257-258	KINGSTON TECHNOLOGY	147
188-189	L A TRADE	260
*	TEXAS INSTRUMENTS	19
179	WORLDWIDE TECHNOLOGIES	264

16 MISCELLANEOUS HARDWARE

Inquiry No.		Page No.
143	CALIFORNIA PC PRODUCTS INC	233
84	INTEGRAND RESEARCH	116
191	PACIFIC COAST MICRO	274
99-100	PC POWER & COOLING	53

17 MODEMS/MULTIPLEXORS

Inquiry No.		Page No.
*	JDR MICRODEVICES	275
*	SUPRA CORP	17

18 MONITORS & TERMINALS

Inquiry No.		Page No.
73-74	CTX INTERNATIONAL INC	207
524-525	DAEWOO	48IS 5
165	DATALUX CORP	252
535	GVC CORP (INT'L)	213
552	KUO FENG CORP (INT'L)	211
133-134	MAG INNOVISION	107
92-93	NANAO USA CORP (N.A.)	99
90-91	NANAO USA CORP (N.A.)	213
520	PHILIPS MONITORS (INT'L)	8-9
148-149	POLYCON GMBH DATA SYSTEMS	111
155	SAMSUNG ELECTRONICS	217
113-114	SAMTRON DISPLAYS INC (N.A.)	211
532	SAMTRON (INT'L)	105
138-139	SCEPTRE TECHNOLOGIES	208
87-88	SMILE INTERNATIONAL INC (N.A.)	105
122-123	VIEWSONIC	103

19 MULTIMEDIA/CD-ROM

Inquiry No.		Page No.
159	ADAPTEC	272
135-136	ANTEX ELECTRONICS	178
129	CREATIVE LABS INC	11
247-248	DTC ELECTRONICS HUNGARY	280
144-145	JVC INFORMATION	92
*	NEKOTECH	253
130-131	PROXIMA CORP	108

20 PRINTERS/PLOTTERS

Inquiry No.		Page No.
526	AXIS COMMUNICATIONS (INT'L)	21
*	CANON	128-129
504	COMPUTER FRIENDS	48IS 16
271-272	DATAPRODUCTS	160
*	HEWLETT-PACKARD	37
*	HEWLETT-PACKARD	26-27

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Product Category Information

To receive information for an entire category, circle the appropriate number on the adjacent card.

Hardware	
Accessories/Supplies	1
Add-in Boards	2
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Diagnostic Equipment	53
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9
Graphics Tablets/Mice/ Pen Input	10
Keyboards	11
LAN Hardware	12
Laptops & Notebooks	13
Mail Order	14
Memory/Chips/Upgrades	15
Miscellaneous Hardware	16
Modems/Multiplexors	17
Monitors & Terminals	18
Multimedia/CD-ROM	19
Printers/Plotters	20
Programmable Hardware	21
Scanners/OCR/Digitizers	22
Security	52
Tape Drives	23
UPS/Power Management	24
Software	
Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
Operating Systems	39
OS/2	54
Programming Languages/ Tools	40
Security	41
Shareware	42
Software Duplication	43
Spreadsheets	44
Unix	45
Utilities	46
Windows	47
Word Processing	48
General	
Books/Publications	49
Recruitment	50
Miscellaneous	51

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21 [ ] OS/2
22 [ ] Mac/OS
23 [ ] UNIX (any, including Solaris)
24 [ ] Windows
25 [ ] Windows/NT
26 [ ] NetWare
27 [ ] Other (please describe):
____

E. The number of employees at my location and company-wide area (check one in each column):

	At My Location	Company-Wide
10,000 or more	28 [ ]	33 [ ]
5,000 to 9,999	29 [ ]	34 [ ]
1,000 to 4,999	30 [ ]	35 [ ]
100 to 999	31 [ ]	36 [ ]
Under 100	32 [ ]	37 [ ]

January 1995 90 97 99
Valid until March 31, 1995

Inquiry Numbers 1–187

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68
69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102
103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119
120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136
137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153
154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170
171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187

Inquiry Numbers 188–374

188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204
205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221
222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238
239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255
256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272
273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289
290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306
307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323
324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340
341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357
358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374

Inquiry Numbers 375–561

375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391
392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408
409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442
443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459
460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476
477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493
494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510
511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527
528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544
545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561

Inquiry Numbers 562–748

562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578
579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595
596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612
613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629
630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646
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698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714
715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731
732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748

Inquiry Numbers 749–935

749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765
766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782
783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799
800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816
817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833
834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850
851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867
868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884
885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901
902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918
919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935

Inquiry Numbers 936–1122

936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952
953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969
970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986
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1038 1039 1040 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054
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1072 1073 1074 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088
1089 1090 1091 1092 1093 1094 1095 1096 1097 1098 1099 1100 1101 1102 1103 1104 1105
1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119 1120 1121 1122

Inquiry Numbers 1123–1309

1123 1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134 1135 1136 1137 1138 1139
1140 1141 1142 1143 1144 1145 1146 1147 1148 1149 1150 1151 1152 1153 1154 1155 1156
1157 1158 1159 1160 1161 1162 1163 1164 1165 1166 1167 1168 1169 1170 1171 1172 1173
1174 1175 1176 1177 1178 1179 1180 1181 1182 1183 1184 1185 1186 1187 1188 1189 1190
1191 1192 1193 1194 1195 1196 1197 1198 1199 1200 1201 1202 1203 1204 1205 1206 1207
1208 1209 1210 1211 1212 1213 1214 1215 1216 1217 1218 1219 1220 1221 1222 1223 1224
1225 1226 1227 1228 1229 1230 1231 1232 1233 1234 1235 1236 1237 1238 1239 1240 1241
1242 1243 1244 1245 1246 1247 1248 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258
1259 1260 1261 1262 1263 1264 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275
1276 1277 1278 1279 1280 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292
1293 1294 1295 1296 1297 1298 1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309

Inquiry Numbers 1310–1489

1310 1311 1312 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326
1327 1328 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343
1344 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359 1360
1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377
1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1392 1393 1394
1395 1396 1397 1398 1399 1400 1401 1402 1403 1404 1405 1406 1407 1408 1409 1410 1411
1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423 1424 1425 1426 1427 1428
1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1442 1443 1444 1445
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Hardware	
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Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Diagnostic Equipment	53
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9
Graphics Tablets/Mice/ Pen Input	10
Keyboards	11
LAN Hardware	12
Laptops & Notebooks	13
Mail Order	14
Memory/Chips/Upgrades	15
Miscellaneous Hardware	16
Modems/Multiplexors	17
Monitors & Terminals	18
Multimedia/CD-ROM	19
Printers/Plotters	20
Programmable Hardware	21
Scanners/OCR/Digitizers	22
Security	52
Tape Drives	23
UPS/Power Management	24
Software	
Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
Operating Systems	39
OS/2	54
Programming Languages/ Tools	40
Security	41
Shareware	42
Software Duplication	43
Spreadsheets	44
Unix	45
Utilities	46
Windows	47
Word Processing	48
General	
Books/Publications	49
Recruitment	50
Miscellaneous	51

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Name ____________________ Title ____________________

Company ____________________ Address ____________________

City ____________________ Country ____________________ Code ____________________

Phone ____________________ Fax ____________________

A. My job function is best classified as (check one):
1 [ ] Company Management
2 [ ] IS/MIS/IT Management
3 [ ] Systems Engineering/Integration
4 [ ] Systems/Networking Consulting
5 [ ] Departmental Management (non-IS/MIS)
6 [ ] Technical Services Support
7 [ ] Other (please describe)
____

B. What is your organization's primary business activity at this location (check one):
8 [ ] Business Services (Finance, Banking, Insurance, Healthcare, Professional)
9 [ ] Commerce/Industry (Retail, Wholesale, Construction, Mining, Manufacturing, Transportation)
10 [ ] Reseller/OEM (VAR, VAD, Systems/Network Integrator, Computer Product Manufacturer)
11 [ ] Government (Federal, State, Municipal, Military)
12 [ ] Computer Services (Support, Training, Consulting)
13 [ ] Other (please specify):
____

C. Please indicate which specific fields of interest are important to you so that BYTE may serve you with supplemental information that best meets your needs (select all that apply):
14 [ ] UNIX and Workstations
15 [ ] Networking (LANs, WANs, and Telecommunications)
16 [ ] Multimedia
17 [ ] Reselling/Systems Integration
18 [ ] Applications Development
19 [ ] Other (explain):
____

D. My responsibilities require that I be involved with the following operating system environments (check all that apply):
20 [ ] DOS
21 [ ] OS/2
22 [ ] Mac/OS
23 [ ] UNIX (any, including Solaris)
24 [ ] Windows
25 [ ] Windows/NT
26 [ ] NetWare
27 [ ] Other (please describe):
____

E. The number of employees at my location and company-wide area (check one in each column):

	At My Location	Company-Wide
10,000 or more	28 [ ]	33 [ ]
5,000 to 9,999	29 [ ]	34 [ ]
1,000 to 4,999	30 [ ]	35 [ ]
100 to 999	31 [ ]	36 [ ]
Under 100	32 [ ]	37 [ ]

January 1995 90 97 99
Valid until March 31, 1995

Inquiry Numbers 1–187

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187

Inquiry Numbers 188–374

188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204
205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221
222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238
239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272
273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289
290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306
307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323
324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357
358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374

Inquiry Numbers 375–561

375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391
392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408
409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425
426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442
443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476
477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493
494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527
528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561

Inquiry Numbers 562–748

562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578
579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595
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681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697
698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714
715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731
732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748

Inquiry Numbers 749–935

749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765
766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782
783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799
800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816
817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833
834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850
851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867
868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884
885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901
902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918
919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935

Inquiry Numbers 936–1122

936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952
953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969
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1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105
1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122

Inquiry Numbers 1123–1309

1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139
1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156
1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173
1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190
1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207
1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224
1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241
1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258
1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275
1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292
1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309

Inquiry Numbers 1310–1489

1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326
1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343
1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360
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1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1423	1424	1425	1426	1427	1428
1429	1430	1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	1441	1442	1443	1444	1445
1446	1447	1448	1449	1450	1451	1452	1453	1454	1455	1456	1457	1458	1459	1460	1461	1462
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INDEX TO ADVERTISED PRODUCTS

Category No.

Inquiry No.		Page No.
*	HEWLETT-PACKARD	62-63
*	HEWLETT-PACKARD	90-91
527	MANNESMANN TALLY	48IS 21
120	TEKTRONIX	77
125	XEROX OFFICE DOCUMENT SYSTEMS	142-143

21 PROGRAMMABLE HARDWARE

160	BUFFALO PRODUCTS	272
197	DATAMAN LTD	280
220-221	DAVISON-WORTH CORP	280
510-511	FAST HARDLOCK (INT'L)	31
*	JDR MICRODEVICES	275
296-297	MARX DATENTECHNIK GMBH	164
110	RAINBOW TECHNOLOGIES	55
277-278	WIBU	162
213	Z-WORLD ENGINEERING	281

22 SCANNERS/OCR/DIGITIZERS

547-548	RECOGNITA (INT'L)	99

52 SECURITY

501	CHERRY MIKROSCHALTER GMBH	48IS 6-7
296-297	MARX DATENTECHNIK GMBH	164
110	RAINBOW TECHNOLOGIES	55
277-278	WIBU	162

23 TAPE DRIVES

289-290	COMPUTER CONNECTIONS INT BV	60
80	EXABYTE CORP	71
202	LAGUNA DATA SYSTEMS	281
172-173	MICRO SOLUTIONS COMP PROD	257
174-175	MICRO SOLUTIONS COMP PROD	259
206	QUALSTAR CORP	281
226-227	SHAFFSTALL CORP	281

24 UPS/POWERMANAGEMENT

62	AMERICAN POWER CONVERSION	32-33
63-64	BEST POWER TECHNOLOGY	87
254-255	DELTEC / NSSI	156
518-519	MINUTEMAN	48IS 11
99-100	PC POWER & COOLING	53

SOFTWARE

25 BUSINESS

69	COMPUTER ASSOC SUPERPROJECT	44
234	DESIGNER CHECKS	281
130-131	PROXIMA CORP	108

26 CAD/CAM

536	ARTEK SRL	48IS 15
85-86	INTERGRAPH	97

27 COMMUNICATIONS/ NETWORKING

154	BOOKLINK TECHNOLOGIES INTERNETWORKS (N.A.)	85
538-539	BTRIEVE TECHNOLOGIES	48IS 30-31
288	CLARK DEVELOPMENT CO INC	283
502-503	COMPEX INC	48IS 23
253	DATASTORM TECHNOLOGIES	137
168-169	FIRST SOURCE INT'L	262
146-147	JSB	237
529	LANSOURCE	48IS 27
224-225	MYSTIC SOFTWARE	283
101	PERSOFT INC	199
275-276	QUALCOMM	160
292	SMC / STANDARD MICROSYSTEMS CORP	141
117-118	SPSS INC	113
516-517	STAC STORAGE & COMMUNICATIONS	CIV
96-97	STAC STORAGE & COMMUNICATIONS	47
528	TRAVELING SOFTWARE (INT'L)	73
521	WALKER, RICHER & QUINN	48IS 9

Category No.

28 DATA ACQUISITION

Inquiry No.		Page No.
205	NATIONAL INSTRUMENTS	281
514-515	NATIONAL INSTRUMENTS	48IS 12

29 DATABASE

65-66	BORLAND INTERNATIONAL	CII-1
284-285	BORLAND INTERNATIONAL	15
538-539	BTRIEVE TECHNOLOGIES	48IS 30-31
196	COMPUTERWISE	282
275-276	QUALCOMM	160

31 ENGINEERING/SCIENTIFIC

69	COMPUTER ASSOC SUPERPROJECT	44
85-86	INTERGRAPH	97
537	INTERSIS AUTOMACAO	48IS 22
127-128	ITERATED SYSTEMS	198
205	NATIONAL INSTRUMENTS	281
184-185	SCITECH INTERNATIONAL	269

33 GRAPHICS

263-264	AT&T MULTIMEDIA S/W SOLUTIONS	153
252	COREL DRAW	139
72	COREL FLOW	35
235	EMATEK GMBH	282
92-93	NANAO USA CORP (N.A.)	99
90-91	NANAO USA CORP (N.A.)	213
130-131	PROXIMA CORP	108
208	SCIENTIFIC ENDEAVORS	282

34 MACINTOSH

513	LOGIC PROGRAMMING ASSOCIATES	48IS 22

35 MAIL ORDER

161	COMPUTER DISCOUNT WAREHOUSE	250-251
505	COMPUTER QUICK	48IS 8
512	GREY MATTER LTD	48IS 18

36 MATHEMATICAL/STATISTICAL

119	STATSOFT	95

37 MISCELLANEOUS SOFTWARE

523	ON TIME MARKETING	48IS 24

38 ON-LINE SERVICES

*	AMERICA ONLINE INC (N.A)	48A-B
450	BIX	295
251	COMPUSERVE	135
281	DELPHI INTERNET SERVICES	157

39 OPERATING SYSTEMS

242-243	ACC CORP	282
256	IBM OS/2 WARP	118-119
186-187	IGC INC	265
*	NETWORK COMPUTING DEVICES (N.A.)	59
259-260	QUARTERDECK OFFICE SYSTEMS	124
298-299	QUARTERDECK OFFICE SYSTEMS	173

40 PROGRAMMING LANGUAGES/ TOOLS

65-66	BORLAND INTERNATIONAL	CII-1
284-285	BORLAND INTERNATIONAL	15
70	COMPUTER ASSOC VISUAL EXPRESS	67
71	COMPUTER ASSOC VISUAL OBJECTS	79
*	COPIA INTERNATIONAL LTD	48
235	EMATEK GMBH	282
67-68	GREENVIEW DATA	57
513	LOGIC PROGRAMMING ASSOCIATES	48IS 22
89	MICROWAY	236
246	OBJECT MANAGEMENT LABORATORY	282
523	ON TIME MARKETING	48IS 24
102	PHAR LAP SOFTWARE INC	170
115	SEQUITER SOFTWARE INC	185
266	SOFTBLOX INC (INT'L)	163
265	SOFTBLOX INC (N.A.)	163

Category No.

Inquiry No.		Page No.
546	TYPHOON SOFTWARE (P.C.)	284
124	WATCOM C/C++ 10.0	29

41 SECURITY

61	ALADDIN KNOWLEDGE SYSTEMS	74
508-509	EUTRON	48IS 28
510-511	FAST HARDLOCK (INT'L)	31
82-83	GLENCO ENGINEERING	115
296-297	MARX DATENTECHNIK GmbH	164
110	RAINBOW TECHNOLOGIES	55
116	SOFTWARE SECURITY	48
277-278	WIBU	162

45 UNIX

*	COPIA INTERNATIONAL LTD	48
81	FRAME TECHNOLOGY (N.A.)	21
67-68	GREENVIEW DATA	57
*	NETWORK COMPUTING DEVICES (N.A.	59
107	QNX SOFTWARE SYSTEMS LTD	195

46 UTILITIES

61	ALADDIN KNOWLEDGE SYSTEMS	74
237	CONSOLIDATED SOFTWARE PRODUCTS	283
140	LOGICIELS ET SERVICES DUHEM	190
180	MICRO 2000	268
181	MICRO 2000	271
105	PKWARE INC	86
106	PKWARE INC	98

47 WINDOWS

*	COPIA INTERNATIONAL LTD	48
253	DATASTORM TECHNOLOGIES	137
239	FUZICALC	283
152-153	ICONOVEX INC	46
513	LOGIC PROGRAMMING ASSOCIATES	48IS 22
249-250	MENAI CORP	283
224-225	MYSTIC SOFTWARE	283
92-93	NANAO USA CORP (N.A.)	99
90-91	NANAO USA CORP (N.A.)	213
101	PERSOFT INC	199
209	SILICONSOFT INC	283
262	WINBOOK COMPUTER CORP (N.A.)	131

48 WORD PROCESSING/DTP

81	FRAME TECHNOLOGY (N.A.)	21
152-153	ICONOVEX INC	46
132	SERIF INC	69

GENERAL

49 BOOKS/PUBLICATIONS

*	BUSINESS WEEK (INT'L)	131
*	BYTE READER	243
*	COMPUTER BOOK CLUB (N.A.)	73
*	OSBORNE MCGRAW-HILL	168-169
*	OSBORNE MCGRAW-HILL	177
98	PANASONIC OFFICE AUTOMATION	214

51 MISCELLANEOUS

*	BYTE BACK ISSUES	48IS 10
*	BYTE CARD DECK	284
*	BYTE EDITORIAL SURVEY	140
*	BYTE EURODECK	48IS 14
291	BYTE ON CD ROM	189
*	BYTE REPRINTS	260NE 1
*	BYTE REPRINTS	260SO 1
*	BYTE REPRINTS (INT'L)	85
*	BYTE SUB MESSAGE	190
*	BYTE WAREHOUSE	234
288	CLARK DEVELOPMENT CO INC	283
*	MCGRAW-HILL ON-LINE (INT'L)	59
*	NEC	38-39
*	NETWORKS SHOW '94	48IS 24

EDITORIAL INDEX

For more information on any of the companies covered in articles, columns, or news stories in this issue, circle the appropriate inquiry number on the response card. Each page number refers to the first page of the article or section in which the company name appears. IS pages appear only in the International edition.

Inquiry No.		**Page No.**
	A	
1150	Accent Software International	231
1435	Acer	48IS 7
1329	Acquired Knowledge	246
1437	Adept Scientific Micro Systems	48IS 8
1105, 1106	ADI Systems	204
1326	Adobe Systems	49, 93, 101, 245
1290	AdvanSys	241
1460	AFP Solutions	48IS 19
1022	AimTech	48IS 28
1107	Amdek	204
	America Online	40
1302	Annabooks	244
1011	Apple Computer	41, 49, 64, 75, 93, 109, 175
1309	Artisoft	49, 245
1467	Artisoft Europe	48IS 22
1282	ASF Associates	241
	AT&T	25, 49, 64, 75, 125, 149
1000	Autodesk	201
	Automatic Data Processing	155
	Avid Technology	34
	B	
1277	B&B Electronics Manufacturing	240
1425	Bakker Electronics	48IS 3
1327	Ballard Synergy	245
1288	BBN Internet Services	125, 240
1279	Belkin Components	240
	Bell Atlantic	149
	Bellcore	64
	BellSouth	149
1151	Berkeley Systems	231
1146	Boca Research	133
1010	Borland International	133, 193
	Brainstorm Technologies	25
1314	Bristol Technology	247
	C	
	Canon	49, 109
1330	CBIS	246
1431	Cellware Breitband Technologie	48IS 7
1450	Chase Research	48IS 14
1439	CIC Computers	48IS 10
1271	Citizen America	240
1291	CNet Technology	242
	Collabra Software	49
1443	Colortrac	48IS 12
	Compaq Computer	49
	Component Integration Laboratories	49
	CompuServe	40
1283	Computer Connections America	241
1438, 1444, 1480	Computers Unlimited	48IS 8, 48IS 12, 48IS 30
	Computer Telephony Expo	145
	ComTel Telecommunications	149
1458	Comunycarse Network Consultants	48IS 19
	Connectix	49
1284	Consumer Technology Northwest	241
1023	Contemporary Software	48IS 30
	Corel	49
	Creative Labs	145
1306	Crescent Software	244
1321	Cross Wind Technologies	247
1478	C2C Systems	48IS 30
1108, 1109	CTX International	204
	Cyberia Communications	36
1156	Cybermedia	231
	D	
1319	D&G Infosystems	244
1441	Dassault Automatismes et Telecommunications	48IS 12
1477	Data Access	48IS 26
	Dataquest	145
1163	Data Race	231
1296	Datasonix	242
	Data Translation	34
	Davis Associates	149
	D-Cubed	201
	DEC	30, 49, 64, 109, 296
	Dell Computer	133
	Delphi	40
	Delphi Consulting	36
1333	Development Technologies	247
1334	Diamond Head Software	247
1147	DigiBoard	133
	DigiCash	125
1159	Digital Products	231
1447	Discworth	48IS 16
	Dragon Systems	49
1110	Dyna Micro	204
	E	
	Eastman Kodak	93, 109
1472	EDM Consultants	48IS 28
1462	Elektroson	48IS 20
1294	Ensoniq	242
	Enterprise Integration Technologies	75
	Epson America	49, 109
1111, 1112	ETC Computer	204
1272	E-Tech Research	241
	Ex Machina	64
1293	Extended Systems	242
	F	
1007	Farallon Computing	75, 229
	Fargo Electronics	109
1445	Fast Electronics	48IS 16
1320	Firefox	247
	Fluke	49
	Folio	49
	Fuji	48IS 12
1292	Fujitsu Personal Systems	242
1335	FuziWare	247
	G	
1305	Galacticomm	244
1324	GammaLink	247
	Gateway 2000	133
	General Magic	49, 64
	Global SchoolNet Foundation	75
	Global Village	49
1113	Goldstar USA	204
1471	Grey Matter	48IS 26
	GTE	64
	H	
	Hasselbad	48IS 12
1148	Hayes Microcomputer Products	133
1155	Headquarters Software	231
1274	Hewlett-Packard	49, 93, 109, 120, 133, 240
1470	Hi Resolution	48IS 19
1367	Hitachi America	204
1423	Hitachi New Media	48IS 7
1012	HSC Software	49, 171
	I	
1160	IBM	30, 41, 49, 133, 231
	IBM/Bell South	49
1154	IBM Microelectronics	231
1114, 1368	IBM PC	204
	Iconovex	36
1115, 1369, 1370, 1371	Idek/Liyama	204
1281	Imagraph	241
1422	IMC	48IS 4
1304	Inference	244
	Intergraph	49, 201
1427	Interlink Communications	48IS 3
1428	Intermec	48IS 4
	International Meta Systems	36
1275	International Micro Electronics Group	240
	InText Systems	36
	Intuit	49, 155
1276	ISDN*tek	242
	J	
1455	Jandel Scientific	48IS 19
	Jasik Designs	49
	K	
1461	KT Distribution	48IS 20
	L	
1479	Laiden University	48IS 28
1285	Laserex	241
1299, 1337	Lenel Systems International	245, 246
	Lexmark	109
	Light Source Computer Images	93
1278	Logicode Technology	240
1005	Lotus Development	24, 183
	M	
1475	Magic Computer Services	48IS 27
1116, 1117, 1372	MAG Innovision	204
1317	Mainstay	246
1289	Maxi Switch	242
1118	Megatron	204
1436	Memorex Telex	48IS 10
	Menai	40
	Metrowerks	49
	Microfield Graphics	49
1003	Micrografx	183
1157	Micronics Computers	231
1006, 1165	Microsoft	28, 41, 49, 93, 145, 149, 155, 165, 183, 231
1286	MindWorks	241
1440	Mitsubishi Electric	48IS 10
1119, 1373	Mitsubishi Electronics America	204
1451	M. L. Electro-Optics	48IS 14
1424	Modranskå	48IS 3
1152, 1310	Modular Software Systems	231, 245
1465	Mondas Information Technology	48IS 22
1316	MoneySoft	246
	Motorola	49
1454	MultiTech Systems	48IS 8
	N	
1120, 1121, 1374	Nanao USA	101, 204
	The National Center for Supercomputing Applications	75
	National Institute of Standards and Technology	75
1463	National Instruments	48IS 20
	National Payment Clearinghouse	155
	National Science Foundation	75
	National Semiconductor	75
1013, 1122	NEC Technologies	165, 204
1167	Netscape Communications	197
	NexGen	49
	Next	41
1328	No Hands Software	245
1123, 1124, 1375	Nokia Display Products	204
1161	Novell	149, 231
1125, 1126, 1376, 1377	NSA Hitachi	204
	O	
1002	Oberon Microsystems	227
1433	Océ-Engineering Systems	48IS 16
	Ohio Supercomputer User Services	75
1426	Olivetti	48IS 3
1127	Optiquest	204
	Oracle	36
1128, 1129	Orchestra Multisystems	204
1474	Oxford University Press	48IS 27
	P	
	Pacific Bell	64
1149	Pacific CommWare	133
1130	Panasonic Communications & Systems	204
1315	Pantone	93, 246
1469	PC Security	48IS 24
1468	PDI Systems	48IS 26
1473	Persoft	48IS 27
1346, 1378	Philips Consumer Electronics	204
1430	Philips Industrial Automation Systems	48IS 4
1287	Plaintree Systems	242
1014	Plextot	49, 165
	Price Waterhouse	25
1301	Process Automation Software and Services	247
1312	Process Software	245
1322	Prodea Software	247
	The Profit Group	165
1001	Prograph International	179
1009	Proxima	191
	Q	
	Quark	93
	Quarterdeck Office Systems	75
1295	Quatech	241
1347	Qume	204
	R	
	Radish Communications	145
1348, 1379	Radius	101, 204
1300	Ram Research	246
1380	RasterOps	101, 204
1323	RBC	247
1349	Relisys	204
1449	ReNet	48IS 14
1464	Roderick Manhattan Group	48IS 20
	RSA Data Security	75
1273	RSI Systems	242
	S	
1350, 1351	Samsung Electronics America	204
1352	Samtron Displays	204
	Sandia National Labs	75
1353, 1354	Sceptre Technologies	204
1457	Sentfactor	48IS 22
1429	Siatel	48IS 4
1308	Silanis Technology	245
	Silicon Graphics	93, 201
1355, 1356	Smile International	204
1476	Softkey International	48IS 30
1004	Software Publishing	183
1442	Software Security International	48IS 7
	Software 2000	25
1357, 1364	Sony Electronics	49, 204
	Spry/O'Reilly & Associates	49
1332	SPSS	247
1311	Statware	246
1313	Stefra	245
1153	Strategic Simulations	231
	Stylus Innovations	49, 149
	Sun Microsystems	75, 93
1432	Sunnyside Systems	48IS 4
	SunSoft	93
	SuperMac Technology	75
1164	Supra	231
1298	System Essentials	244
	T	
	Tadpole Technology	49
	Taligent	93, 227
1448	Tandberg Data	48IS 4
1358, 1365	Tatung	204
1015	TEAC America	165
	Tektronix	93, 109
	Texas Instruments	41, 49, 109
1331	TexaSoft	246
	Thinking Machines	45
1297	3M Optical Systems	240
1336	Thursby Software	247
1016	Toshiba	49, 165
1325	Trend Micro Devices	244
1303	Trumatch	93, 244
1008	Tut Systems	49, 229
1359, 1366	TVM Professional Monitor	204
	U	
1307	Ulead Systems	244
	Uptime Computer Solutions	25
	U.S. Sprint	75
	V	
1360, 1361, 1362, 1381	ViewSonic	204
1421	Viglen	48IS 3
1466	Visual Software Exports	48IS 24
	Vodavi Communications Systems	149
	Voice Power Technologies	149
	W	
1434	Wacom Computer Systems	48IS 7
	Watcom	49
1338	Wolfram Research	245
1456	Wollongong	48IS 20
	X	
	Xerox	109, 227
1162	Xircom	231
	Y	
1459	The York Group	48IS 19
	Z	
1166, 1363	Zenith Data Systems	204, 231
1280	Z-World Engineering	240
1318	Zzyzx	246

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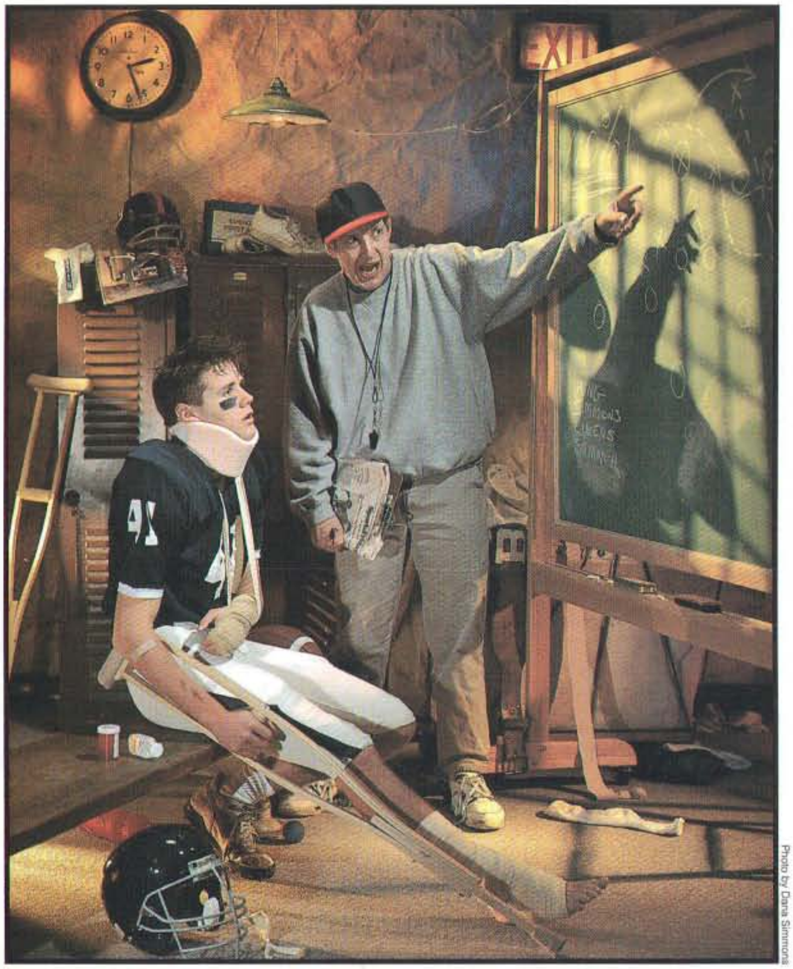

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Commentary **Richard Jennings**

Who Needs the Internet?

A net vet explains why he no longer needs FTP, newsgroups, or other obsolete features

The Internet is obsolete. Everything I used to do on it I can do now with more modern technology. I would rather we have a telephone infrastructure that supports 28.8-Kbps modems—to speed up communications—and a national caller-ID service—to screen out the communications I don't want.

In my defense, I have been a reasonably active Internet user for the past 16 years. My original terminal was a 24-row by 80-column VDT, which was connected to a DEC PDP-10. It in turn had a direct connection, via an impish Interface Message Processor, to the Internet. My communications network, free to me, consisted of everything between the PDP-10 and the service provider. I reached out for three basic services: mail, file transfer (FTP), and remote log-in (Telnet).

Back then, I used Telnet to access, for example, a symbolic mathematical program (Macsyma, hosted on a PDP-20 at MIT) and the Network Information Center data servers. These servers contained databases of phone numbers of people in the government and all kinds of technical reports about the standards implementing the Internet.

Today, Mathematica (far superior to Macsyma) resides happily on my notebook. My CD-ROM drive accesses databases that can print a map of your neighborhood. The technical reports are available on an inexpensive CD-ROM.

I used the Internet to share documents by logging in to remote systems to print remotely all over the country. Now my word processor prints to any fax machine in the world just as easily as it prints to my laser printer. After hours, it costs me about 10 cents a page in the U.S. The cost of faxing outside the country has also come down.

I used FTP to move files from repositories on university- or Department of Defense–supported hosts to local hosts. For example, I moved programs to format documents (Scribe), transfer files (Kermit), learn Lisp (XLisp), and format mathematical equations (TeX). No commercial equivalents to these programs existed at that time.

I also used the Internet to grab files from various archives, look at them, and then delete them to make space for the next batch. Now the data, especially images, is compressed (by a factor of up to 800) and is quickly accessible off my shelf in the form of personal CD-ROMs. Today, I can get more information on a CD-ROM than I can read in a year.

I used Internet mail to reach people who were always on the road, in the air, in meetings, or in their office with the phone disconnected "working" on their computers. Most of these people have cellular phones now.

JON FOX © 1995

I also subscribed to several newsgroups, which used to swamp our local hosts. Information contained in these newsgroups was critical to getting hardware and software from different vendors to work together and to keeping the resulting system operational.

But today, CD-ROMs, with software to help me find just the right bits of information, coupled with vendors' fax-back systems and BBSes for late-breaking insights give me the information that I previously acquired by prospecting the newsgroups. I do not need more information now. I do need time to digest it.

Newsgroups also provided interesting, if not always work-related, information (e.g., net.singles and net.bicycles). Sorting through all the electronic data available, even 10 years ago, took a lot of time. Today, I am willing to pay an accountable expert to winnow away the chaff, packaging and distributing the useful kernels to me in a form I can quickly absorb—a magazine or a newsletter.

It is important to acknowledge the contributions of federal managers to the Internet. When I was a government employee, any letter I wrote went through countless reviews. If I made a long-distance phone call, it was logged in. The Internet was an expressway bypassing the bureaucracy.

There was a time when the Internet did fill a void. That void has been filled with other products and services that now render the Internet obsolete. The clamor to revive the Internet with a massive and continuing government subsidy is without any sound support grounded in economic arguments.

To enable their computers to reach out to touch other computers, many people may need to believe in an Internet-like entity. I don't. I believe in a modem and a quality phone line. ■

Richard Jennings is a retired Air Force Major living in Norwich, Vermont. If you want to reach him on the Internet, you'll have to send E-mail to editors@bix.com.

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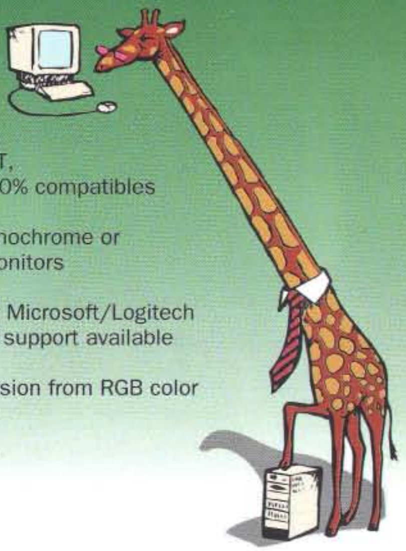

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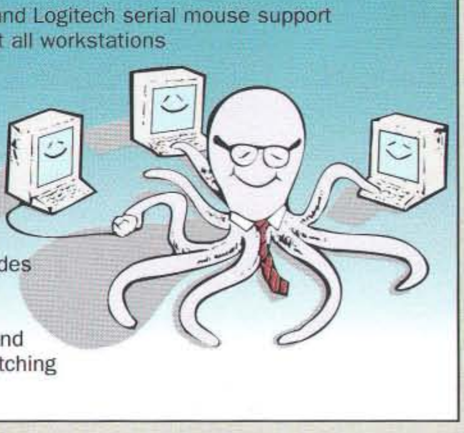

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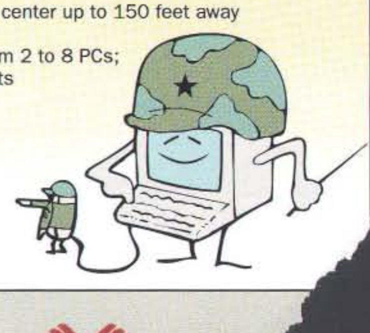

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Remote Control Software. Rated #1. Over and Over and Over…

- ☑ **#1 Overall Evaluation**
- ☑ **#1 Overall Power**
- ☑ **#1 Overall Usability**
- ☑ **#1 Performance**
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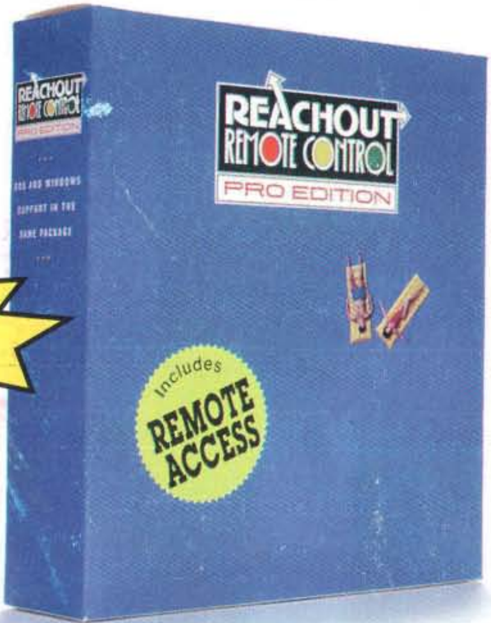

The 45-page review for *Software Digest* covered all the bases. It was the most extensive review ever done on remote control software. In the end, the experts called ReachOut Remote Control simply "the best program in the…evaluation." It outscored the competition in not one, not two or three, but in seven categories. In its report for *Software Digest's* June '94 issue, National Software Testing Laboratories wrote:

> *NSTL recommends ReachOut Remote Control for its excellence in almost every category. No other program matches its number of features or ease of use, and it is the unanimous choice for best program in the testers' general usability evaluation.*

The recommendation confirms the findings of exhaustive corporate evaluations. And it parallels assessments by such leading publications as *Byte, LAN Magazine, PC User, Network Computing, Government Computer News* and *InfoWorld.*

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Before you know it, you'll be using ReachOut. Over and over and over…

THE MOST COMPREHENSIVE REVIEW OF REMOTE CONTROL SOFTWARE

SOFTWARE DIGEST RATING	OVERALL EVALUATION	PROGRAM
★★★★	8.5	Reachout Remote Control
★★★	7.5	Close-Up
★★★	7.3	Norton pcANYWHERE 1.0 for Windows
★★★	7.3	Carbon Copy for Windows

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